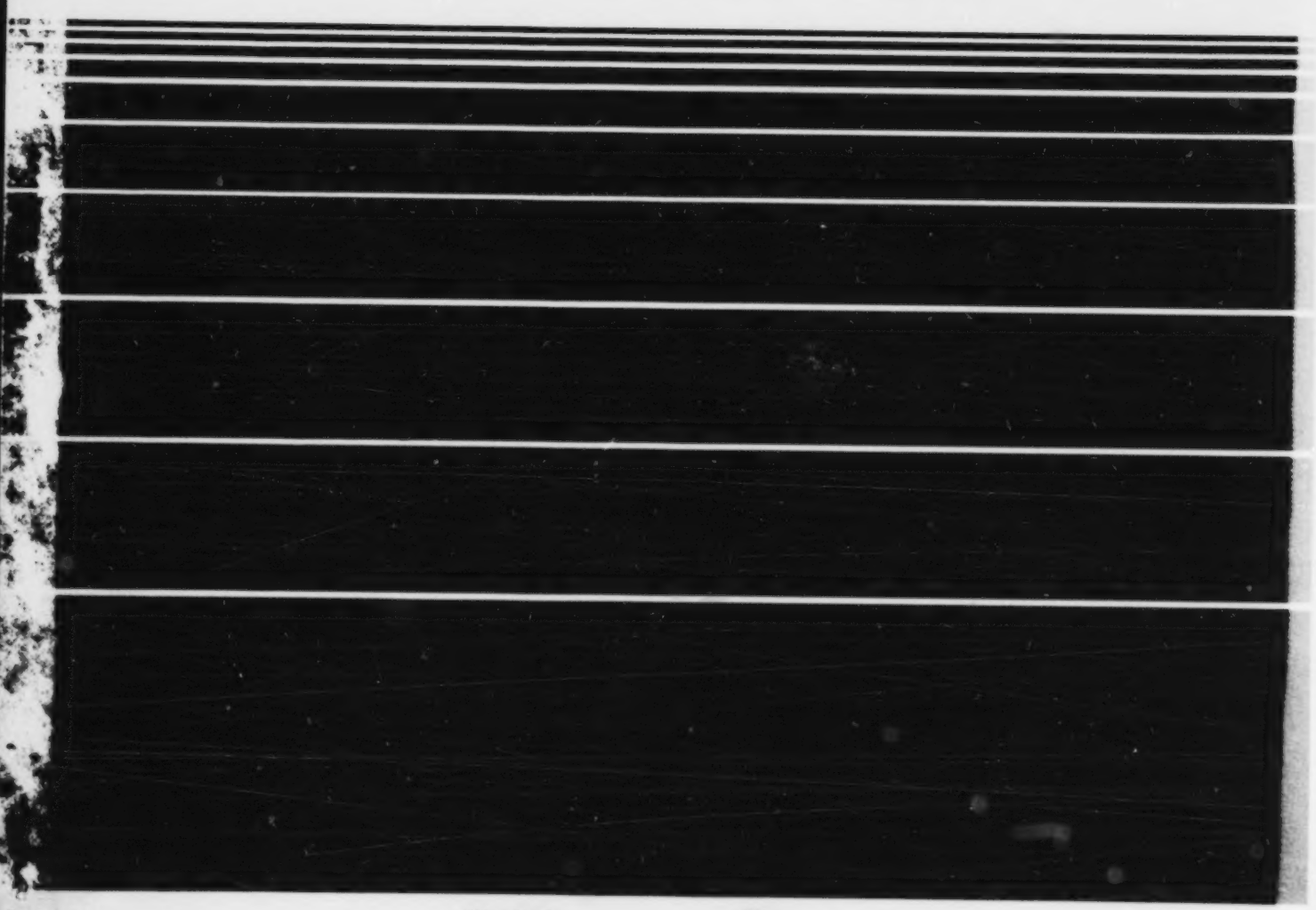

Manitoba
Environment
and Workplace
Safety and Health

MG-8159

MANITOBA AMBIENT AIR QUALITY
ANNUAL REPORT - 1985

Air Standards and Studies Section
Environmental Management Services Branch

Air Standards and Studies
Report No. 88-01
February, 1988

Air Standards and Studies. 1988. Manitoba Ambient Air Quality Annual Report - 1985, Department of Environment and Workplace Safety and Health, Air Standards and Studies Section, Report No. 88-01. pp. 45

ABSTRACT

As part of an on-going environmental quality monitoring program, the Manitoba Department of Environment and Workplace Safety and Health monitored the quality of ambient air at several urban locations during 1985. This monitoring consisted of the use of established monitoring sites having dedicated instrumentation for continuous air sampling and analysis.

The ambient air quality program is structured to determine air quality in two areas: general urban air quality and air quality in the vicinity of specific industries.

The general urban air quality program consisted primarily of sampling activities within the Federal/Provincial National Air Pollution Surveillance (NAPS) program. Sampling at NAPS sites consisted of measurement of the common air pollutants including carbon monoxide, nitrogen dioxide, ozone, sulphur dioxide, total suspended particulate matter, soiling index, lead, sulphates, and nitrates. Of these contaminants, total suspended particulate matter and ozone most often exceeded the Provincial air quality objectives. Based on the Canadian Annual Index of Air Quality, Winnipeg's air quality was rated as "FAIR".

The monitoring of air quality in the vicinity of specific industries having (or potentially having) atmospheric emissions was restricted to the areas around the Northern smelters (at Flin Flon and Thompson), the pulp and paper mill at The Pas, and an ammonia fertilizer manufacturer in Brandon. Monitoring was specifically for the pollutant of industrial emission. Data from the above locations showed that, on occasion, levels above air quality objectives and/or guidelines were measured.

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INTRODUCTION

The Air Standards and Studies Section of Manitoba Environment and Workplace Safety and Health has been monitoring ambient air at several locations throughout Manitoba since 1968. Monitoring activities in 1985 took place in Winnipeg, Brandon, Thompson, Flin Flon and The Pas.

The majority of sampling is of a continuous nature involving dedicated monitors in permanent stations and can be divided into two basic categories; (1) General or Urban Air Quality monitoring and (2) Source specific or Industrial monitoring. Much of the General or Urban Air Quality monitoring is performed under the auspices of the Federal Government's National Air Pollution Surveillance (NAPS) program, which provides a nationwide data base for determining the extent of air pollution in Canada, and also documents trends arising as a result of changing industrial activity, fuel use, population density and use of pollution control strategies.

Source specific or Industrial monitoring is performed by the Impingement Program within the Air Standards and Studies Section. This monitoring contributes to the evaluation of ambient air quality in the vicinity of specific industries in order to determine compliance with Provincial air quality guidelines and objectives.

This report covers the 1985 data for the following parameters: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Nitric Oxide (NO), Ozone (O_3), Ammonia (NH_3), Hydrogen Sulphide (H_2S), Sulphur Dioxide (SO_2), Soiling Index (COH), Total Suspended Particulate (TSP), Lead (Pb), Sulphates (SO_4), and Nitrates (NO_3).

The objectives of this report are; (1) to outline ambient air monitoring activities in the Province during 1985, (2) to provide summary statistics and a comparison to air quality objectives and/or guidelines (where applicable), (3) to compare 1985 data with previous years and (4) to provide a rating of the air quality relative to the Canadian Annual Index of Air Quality.

BACKGROUND

A) Manitoba Air Quality Objectives and Guidelines

The Province of Manitoba has adopted the National Ambient Air Quality objectives for those pollutants for which such objectives have been promulgated (sulphur dioxide, suspended particulate matter, carbon monoxide, ozone and nitrogen dioxide). Air Quality Guidelines have been developed and adopted internally for the remaining pollutants.

The above criteria have been designed about three levels:

Maximum Tolerable Level (MTL) - these criteria pollutant levels are those which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

Maximum Acceptable Level (MAL) - these criteria pollutant levels are intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being.

Maximum Desirable Level (MDL) - these criteria pollutant levels define long term goals for air quality and provide a basis for an antidegradation policy for the unpolluted part of the country and for the continuing development of control technology.

In the majority of cases, urban air quality is expected to meet the MAL, whereas, in rural areas, it is the long term goal to ensure that the MDL's are not exceeded.

A list of "Ambient Air Criteria" currently endorsed by Manitoba Environment and Workplace Safety and Health is presented in Table 1.

TABLE 1

OBJECTIVES AND GUIDELINES FOR VARIOUS AIR POLLUTANTS

AMBIENT AIR CRITERIA

The following schedule lists maximum time-based pollutant concentration levels for the protection and preservation of ambient air quality within the Province of Manitoba. Each contaminant is classified either as objective or guideline status depending upon several factors. The objective classification is directed toward those air pollutants sufficiently widespread in presence and of potential environmental effect that formulation of limits has been thorough and well documented. The guideline classification is used for those pollutants of a more localized presence and for which a lesser degree of documentation in support of the chosen criteria is available.

For the air contaminants mentioned in Column 1, the amount thereof in the outside air measured in the units set out in Columm 2 during the period of time set out in Column 3, shall not be in greater concentration than the amount shown in:

- Column 4 representing the MAXIMUM TOLERABLE LEVEL which denotes a time - based concentration of air contaminant beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.
- Column 5 representing the MAXIMUM ACCEPTABLE LEVEL which is deemed essential to provide adequate protection for soils, water, vegetation, materials, animals, visibility, personal comfort and well-being.
- Column 6 represents the MAXIMUM DESIRABLE LEVEL which defines the long term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of Manitoba and for the continuing development of control technology.

This schedule is intended to serve as a guide for the evaluation of air quality and for planning purposes. The selection of the appropriate concentration category will depend upon the degree of protection to be afforded to effected receptors. Maximum Tolerable Levels are only for evaluation purposes to identify the severity of an anthropogenic or natural phenomenon in order to protect human health and institute appropriate corrective action. In general, Maximum Acceptable Levels are not to be exceeded in any urban centre including areas that are in the vicinity of industries with atmospheric emissions. Within rural areas, it is the goal to maintain pollutant concentrations at or below Maximum Desirable Levels.

COLUMN 1		COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
Name of Contaminant	Contaminant Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Tolerable Level Concentration	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Ammonia	Guideline	milligrams per cubic metre (parts per million) of air	1-hour average		1.4 (2.0)	
Carbon Monoxide	Objective	milligrams per cubic metre (parts per million) of air	1-hour average		35 (30)	15 (13)
			8-hour average	20 (17)	15 (13)	6 (5)
Chromic Acid (as Cr^{+6})	Guideline	micrograms per cubic metre of air	1-hour average		4.5	
Dustfall in Excess of Normal Background Levels	Guideline	milligrams per square centi-metre (tons per square mile per month)	air basin average 30 days		0.8 (22.8)	0.6 (17.1)
			single point 30 days		1.5 (42.8)	1.1 (31.4)
Fluorides (as Fluoridation)	Guideline	micrograms per 100 square centimetres	30 days		40	
Fluorides (as HF)	Guideline	micrograms per cubic metre (parts per billion) of air	24-hr. average		0.85 (1.06)	0.40 (0.50)
			7 day average		0.55 (0.69)	0.22 (0.28)
			30 day average		0.35 (0.44)	
			70 day average		0.20 (0.25)	
Hydrogen Chloride	Guideline	micrograms per cubic metre (parts per million) of air	1-hr. average		100 (.07)	
Hydrogen Sulphide	Guideline	micrograms per cubic metre (parts per billion) of air	1 hour average	1400 (1000)	15 (11.0)	1 (0.7)
			24 hr. average		5 (4.0)	

COLUMN 1		COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
Name of Contaminant	Contaminant Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Tolerable Level Concentration	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Lead	Guideline	micrograms per cubic metre of air	24-hr. average		5.0	
Nitrogen Dioxide	Objective	micrograms per cubic metre (parts per million) of air	1-hour average	1000 (.53)	400 (0.213)	
			24-hr. average		200 (0.106)	
			Annual arithmetic mean		100 (0.053)	60 (0.032)
Odours	Guideline	odour units	two tests not less than 15 minutes apart nor more than 60 minutes apart		Residential Zone 2.0 (one volume of odorous air diluted with one volume of odour free air) Industrial Zone 7.0 (one volume of odorous air diluted with six volumes of odour free air)	<1.0 (less than the odour threshold)
					Also see note on next page	
Oxidants (Ozone)	Objective	micrograms per cubic metre (parts per million) of air	1-hour average	400 (.20)	160 (0.08)	100 (0.05)
			24-hr. average		50 (0.025)	30 (0.015)
			Annual arithmetic mean		30 (0.015)	
Soiling Index	Guideline	coefficient of haze per 1000 feet of air	24-hr. average		1.0	0.45
			Annual arithmetic mean		0.45	0.3

COLUMN 1		COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
Name of Contaminant	Contaminant Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Tolerable Level Concentration	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Sulphation	Guideline	milligrams of sulphur trioxide per 100 square centimetres per day	30 days		1.0	0.4
Sulphur Dioxide	Objective	micrograms per cubic metre (parts per million) of air	1-hour average		900 (0.34)	450 (0.17)
			24-hr. average	800 (.31)	300 (0.11)	150 (0.06)
			Annual arithmetic mean		60 (0.02)	30 (0.01)
Sulphuric Acid Mist	Guideline	micrograms per cubic metre (parts per million) of air	1-hr. average		100 (.025)	
Suspended Particulate Matter	Objective	micrograms per cubic metre of air	24-hr. average	400	120	
			Annual geometric mean		70	60

Note: Odours:
The release of offensive odours past the property line of any source shall be eliminated, or minimized, such that the said odours will not interfere with the comfort, well-being or enjoyment of any person. In most situations, achieving the Maximum Acceptable Level, will satisfy this condition.

All measurements of air quality are corrected to a reference temperature of 25°C and to a reference pressure of 101.3 kilopascals.

Revised

July, 1985

B) POLLUTANTS

Pollutants monitored in the Manitoba Ambient Air Quality Network included:

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless and tasteless gas slightly lighter than air. It is considered a dangerous asphyxiant because it combines strongly with the hemoglobin of the blood and reduces the blood's ability to carry oxygen to cell tissues. CO is a product of incomplete combustion of carbon and is emitted by fossil fuel combustion sources (i.e. motor vehicle). CO is measured on a continuous basis by the technique of non-dispersive infrared spectrometry and the data is generally reported in the unit form of hourly averages from which further time-weighting can be determined.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish-brown gas with a pungent, irritating odour. It originates chiefly from combustion sources as well as from conversion of nitric oxide. Nitrogen dioxide exerts its primary toxic effect on the lungs and can be associated with increased susceptibility to respiratory infections and emphysematous changes. Nitrogen dioxide also suppresses vegetation growth, causes corrosion of metals, reduces visibility and acts as a

precursor with reactive hydrocarbons for oxidant formation. It is measured continuously by the technique of chemiluminescence with unit data reported as hourly averages.

Nitrogen oxides are also recognized as a significant contributor to the formation of acid rain.

Nitric Oxide

Nitric oxide (NO) is a colourless, odourless and tasteless gas which in nature is produced by biological action but in polluted atmospheres is produced primarily by fuel combustion in both stationary and mobile sources. By itself nitric oxide is not usually considered a pollutant but in a polluted atmosphere, it is readily oxidized to nitrogen dioxide through photochemical secondary reaction. Nitric oxide is measured concurrently with nitrogen dioxide by the technique of chemiluminescence and the data is processed as hourly averages.

Ozone

Ozone (O_3) is a pungent irritating gas formed at high altitudes by photochemical reaction involving molecular and atomic oxygen. Ozone and other oxidants are formed in polluted atmospheres as a result of a rather wide variety of photochemical reactions involving nitrogen oxides and reactive hydrocarbons. The overall effect of ozone is a stinging of the eyes and the mucous membranes.

It is also responsible for an increase in asthma effects and respiratory restriction. Ozone reduces vegetation yields, injures vegetation and weakens materials such as rubber and certain fabrics. Ozone is measured by use of the chemiluminescence technique and unit data reported as hourly averages.

Ammonia

Ammonia (NH_3) is a colourless gaseous alkaline compound of nitrogen and hydrogen. It is lighter than air, of extremely pungent smell and taste, and very soluble in water, and can be easily condensed by cold and pressure to a liquid. Ammonia is an important industrial and agricultural compound as well as a nuisance, but it is not a major pollutant of the environment. It is used both free and combined in medicine, the arts and industry. Ammonia is measured continuously by the technique of chemiluminescence with unit data reported as hourly averages.

Hydrogen Sulphide

Hydrogen sulphide (H_2S) is a toxic, foul smelling gas well-known for the rotten egg-like odour at a very low concentration. Hydrogen sulphide as an occasional air contaminant is almost always associated with some specific incident or industrial process. The concentration of hydrogen sulphide in the ambient air is rarely high enough to harm either vegetation or man. However, at high concentrations, it will produce loss of sense of smell, severe respiratory tract irritation and material damage such as the staining

of lead based paints. H_2S is measured continuously by the technique of coulometry/pulsed fluorescence. Unit data is reported as hourly averages.

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a pungent irritating odour emitted primarily from the combustion of fossil fuels containing sulphur, and from primary non-ferrous smelting. It is usually recognized as one of the major atmospheric pollutants. Sulphur dioxide produces an increased frequency of respiratory disease symptoms and lung disease. It also produces marked effects on vegetation, corrodes materials and may oxidize in the atmosphere to form sulphuric acid and sulphates. Sulphur dioxide along with nitrogen dioxide has been determined to contribute to acid rain.

Sulphur dioxide is measured by use of the coulometry and pulsed fluorescence techniques. Unit data is reported as hourly averages.

Soiling Index (Smoke)

Soiling index (COH) is an indication of the soiling or darkening potential of fine particulate in the atmosphere usually resulting from combustion. These particles are usually in the size range of 0.1 to 1 micron in diameter. A tape sampler is used to collect the "smoke" particles on a filter paper and the degree of light transmission on a bi-hourly basis is reported as Coefficient of Haze (COH) units.

Total Suspended Particulate

Total Suspended Particulate (TSP) is a general term which applies to a large variety of solid or liquid particles of a size and configuration such that they remain suspended in the air and can be drawn into the respiratory passages. These types of particles usually in the size range of 0.1 to 100 microns may originate as a result of industrial processes, human activities and from natural sources such as wind swept or entrained dust. By itself, or in association with other pollutants, TSP, in enough concentration, may injure the respiratory system. TSP also may reduce visibility and contribute to property damage and soiling. A high volume air sampler is used to collect the particles on a glass fibre filter and results are reported as integrated 24-hour concentration of mass of particulate matter per volume of air.

Lead

Lead (Pb) exists in the atmosphere primarily as a particulate resulting from the combustion of leaded gasoline and from certain source industries. Exposure to lead will adversely affect human health (especially young children) by absorption into the bloodstream and impairment of heme synthesis in cells. Other adverse effects associated with elevated blood lead levels include the possibility that nervous system damage may occur. Lead is analyzed from a representative portion of the total suspended particulate collected by high volume sampling. Air concentrations are reported as integrated 24-hour concentrations of mass of lead per volume of air.

Sulphates

Sulphates (SO_4) in the atmosphere are primarily in the form of aerosols such as sulphuric acid and in particulates such as compounds of ammonium and zinc sulphates. Particulate sulphates can arise as a result of hydrogen sulphide oxidation and from sea spray, but are primarily formed from the oxidation of sulphur dioxide. Sulphates can impact on health as small particulate which enter the respiratory system and have been associated as a major contributing factor to visibility reduction. Sulphates are measured as a constituent of total suspended particulate and reported as integrated 24-hour concentrations of mass of sulphate per volume of air.

Nitrates

Nitrates (NO_3) in the atmosphere can be in the form of aerosols, gases, and particulate. The nitrate ion is the most oxidized form of nitrogen and the nitrate salts of all common metals are quite water soluble. Particulate nitrate are believed to contribute to atmospheric haze. Particulate nitrate (and sulphates) may be a major part of dry atmospheric acidic deposition. Nitrate levels are particulate nitrate determined as a constituent of total suspended particulate and are reported as integrated 24-hour concentrations of mass of nitrate per volume of air.

C) SAMPLING SITES

Figure 1 is a map of the urban areas included in the Manitoba Ambient Air Quality Monitoring Network. Figures 2 through 6 depict the monitoring locations within each of the urban centres.

Air monitoring stations are listed in a more detailed form in Table 2 as to location, code number, pollutants monitored, and period during 1985 that monitoring took place.

Table 2: Ambient Air Monitoring Sites (1985)

AREA	CODE	SAMPLING SITE LOCATION	SAMPLE PERIOD	POLLUTANTS MONITORED	TYPE
Winnipeg (Downtown)	9119	65 Ellen Street	Jan. - Dec.	SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4, NO_3	NAPS
Winnipeg (Residential)	9118	299 Scotia Street	Jan. - Dec.	SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4, NO_3	NAPS
	* 9120	604 St. Mary's Road	Jan. - Aug.	SO_2, CO, O_3, COH, TSP, Pb, SO_4, NO_3	NAPS
Winnipeg (Roadside)	9102	2120 Portage Avenue	Jan. - Dec.	TSP, Pb, SO_4, NO_3	NAPS
St. Francois Xavier (Winnipeg Background)	4304	MTS Trailer	Jan. - Dec.	TSP, Pb	
Brandon (Downtown)	9201	11th St. & Princess	Jan. - Dec.	TSP, Pb, SO_4, NO_3	NAPS
Brandon (Industrial)	5131	Assiniboine Community College (Lot)	Jan. - Dec.	NH_3, NO_2, NO, O_3,	
The Pas	7111	3rd & Ross (Provincial Building)	Jan. - Dec.	H_2S (TRS)	
Flin Flon	7233	35 Main Street	Jan. - Dec.	SO_2	
	7222	Channing Drive	Jan. - Dec.	SO_2	
Thompson	7344	59 Elizabeth Road	Jan. - Dec.	SO_2	

* As a result of program review and changing priorities, the monitoring at this site ceased in August 1985.

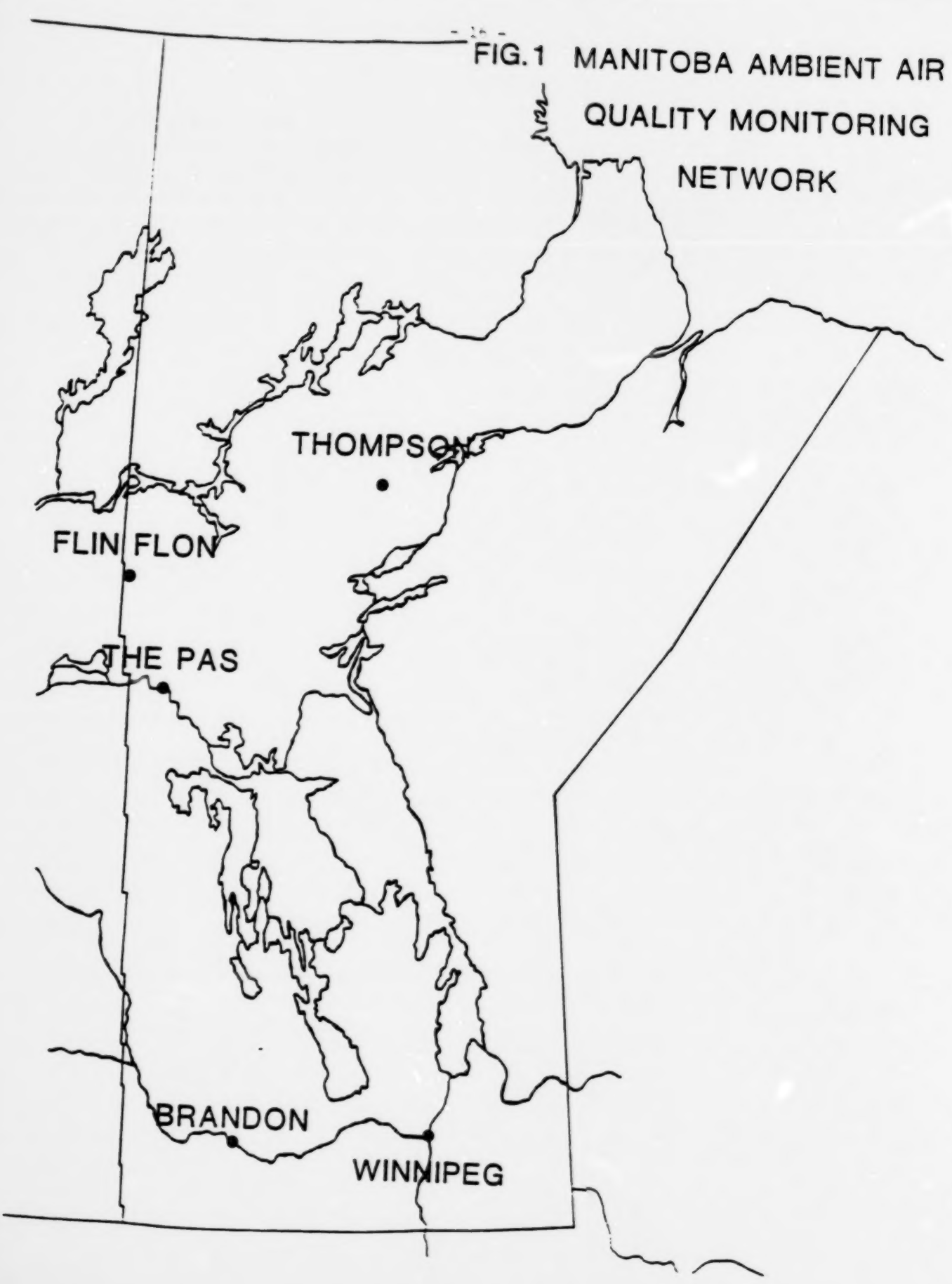


FIG. 1 MANITOBA AMBIENT AIR QUALITY MONITORING NETWORK

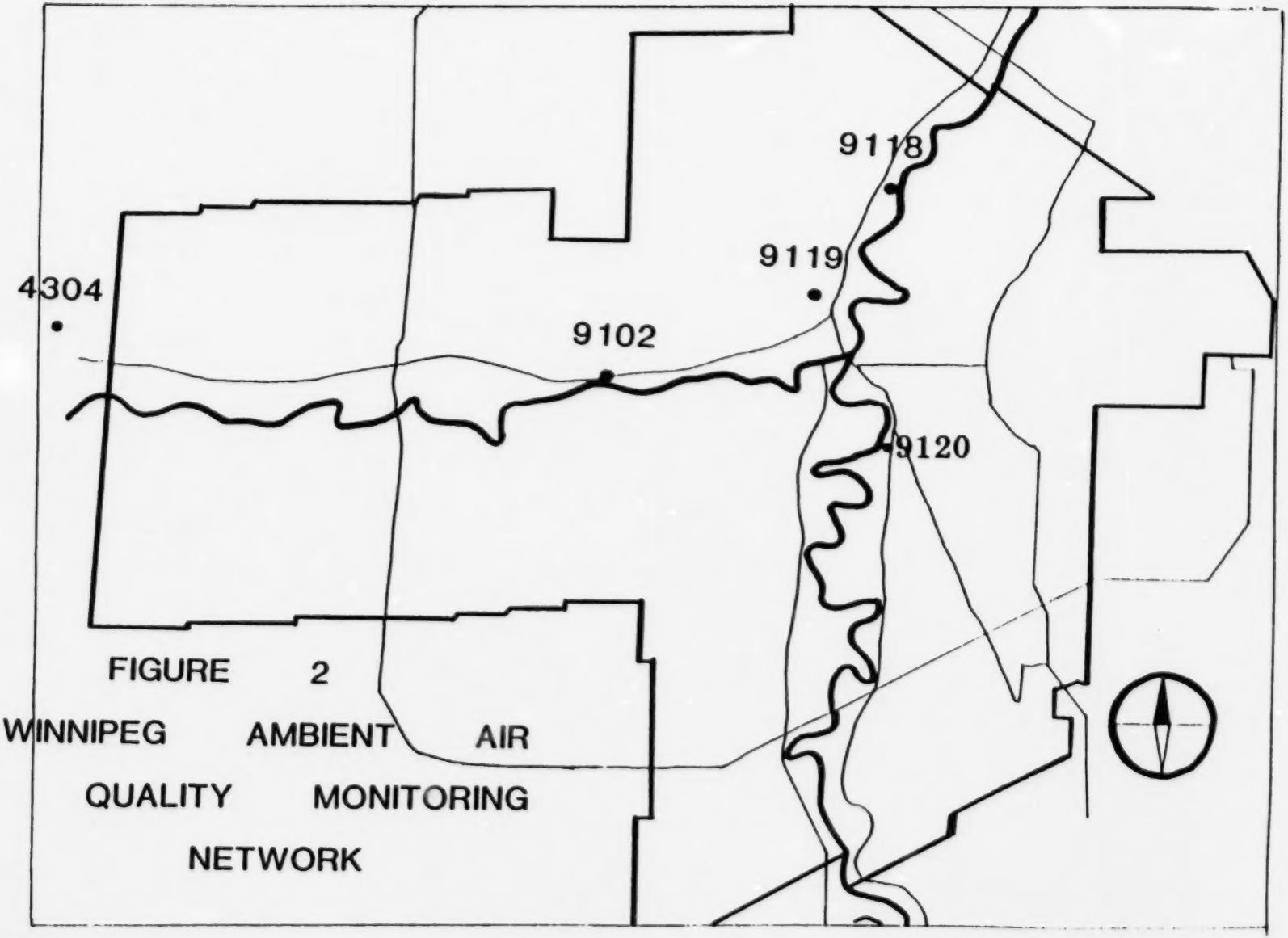


FIGURE 2

WINNIPEG AMBIENT AIR QUALITY MONITORING NETWORK

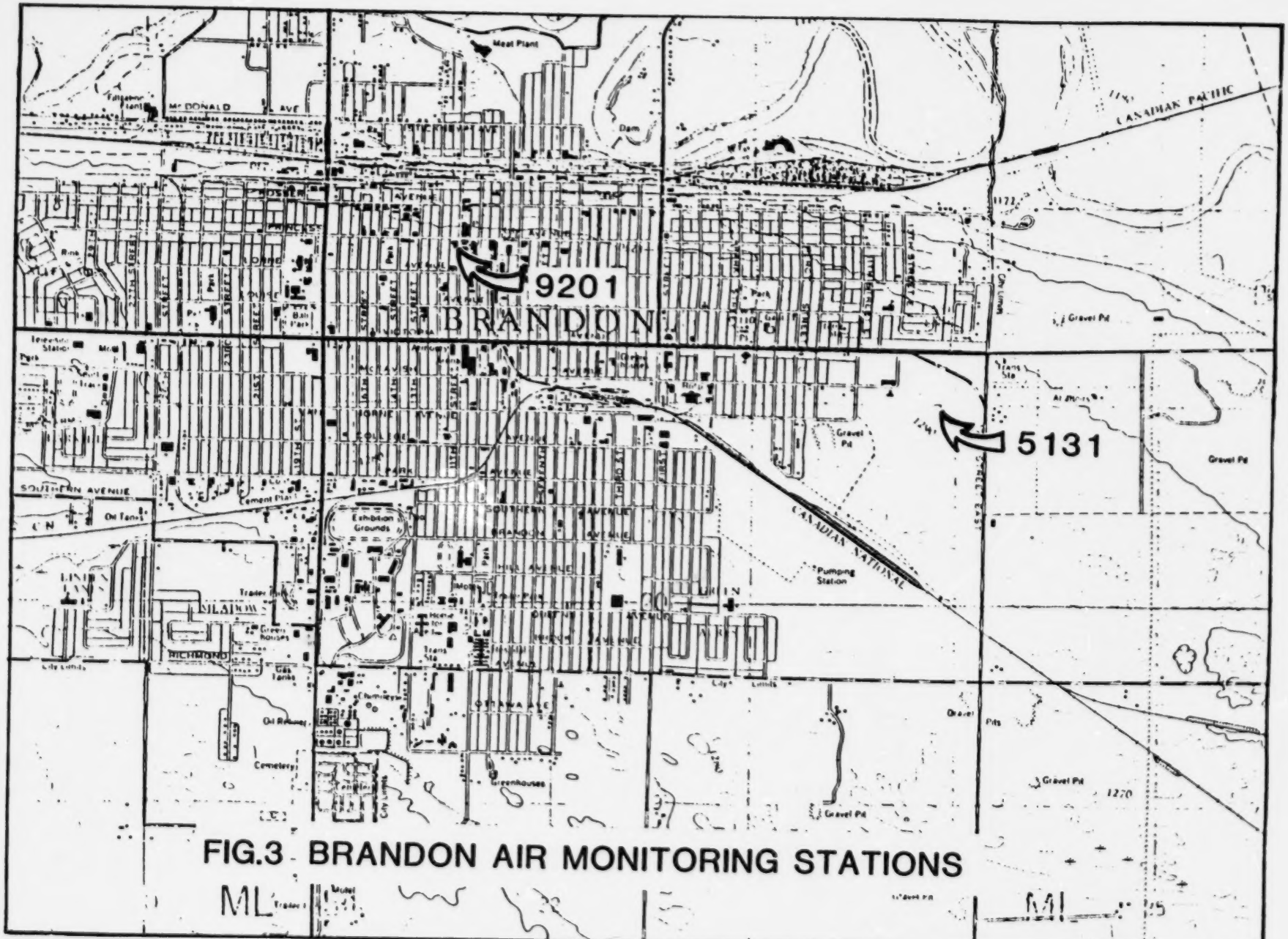
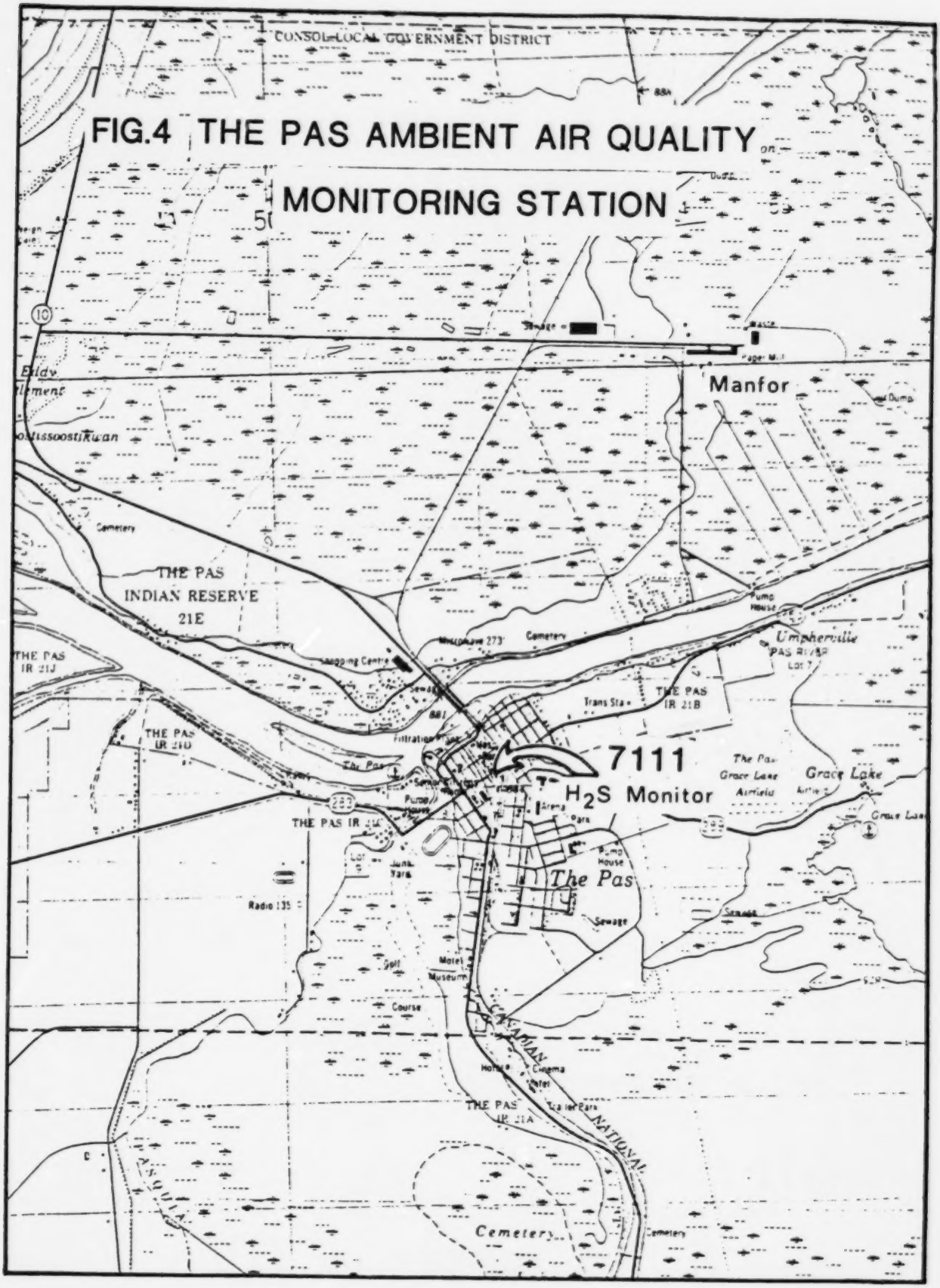


FIG.3 - BRANDON AIR MONITORING STATIONS


CONSOLIDATED LOCAL GOVERNMENT DISTRICT
FIG.4 THE PAS AMBIENT AIR QUALITY
MONITORING STATION
Manfor
THE PAS
INDIAN RESERVE
21E
THE PAS
IR 21J
THE PAS
IR 21D
THE PAS IR 21C
THE PAS
IR 21B
THE PAS IR 21A
7111
H_2S Monitor
The Pas
Umpherville
Grace Lake
Cemetery
Sewage
Pump House
Trans Sta
Filtration
Radio 135
Golf Course
Motel
Museum
Cinema
Hotel
Trailer Park
Cemetery
NATIONAL

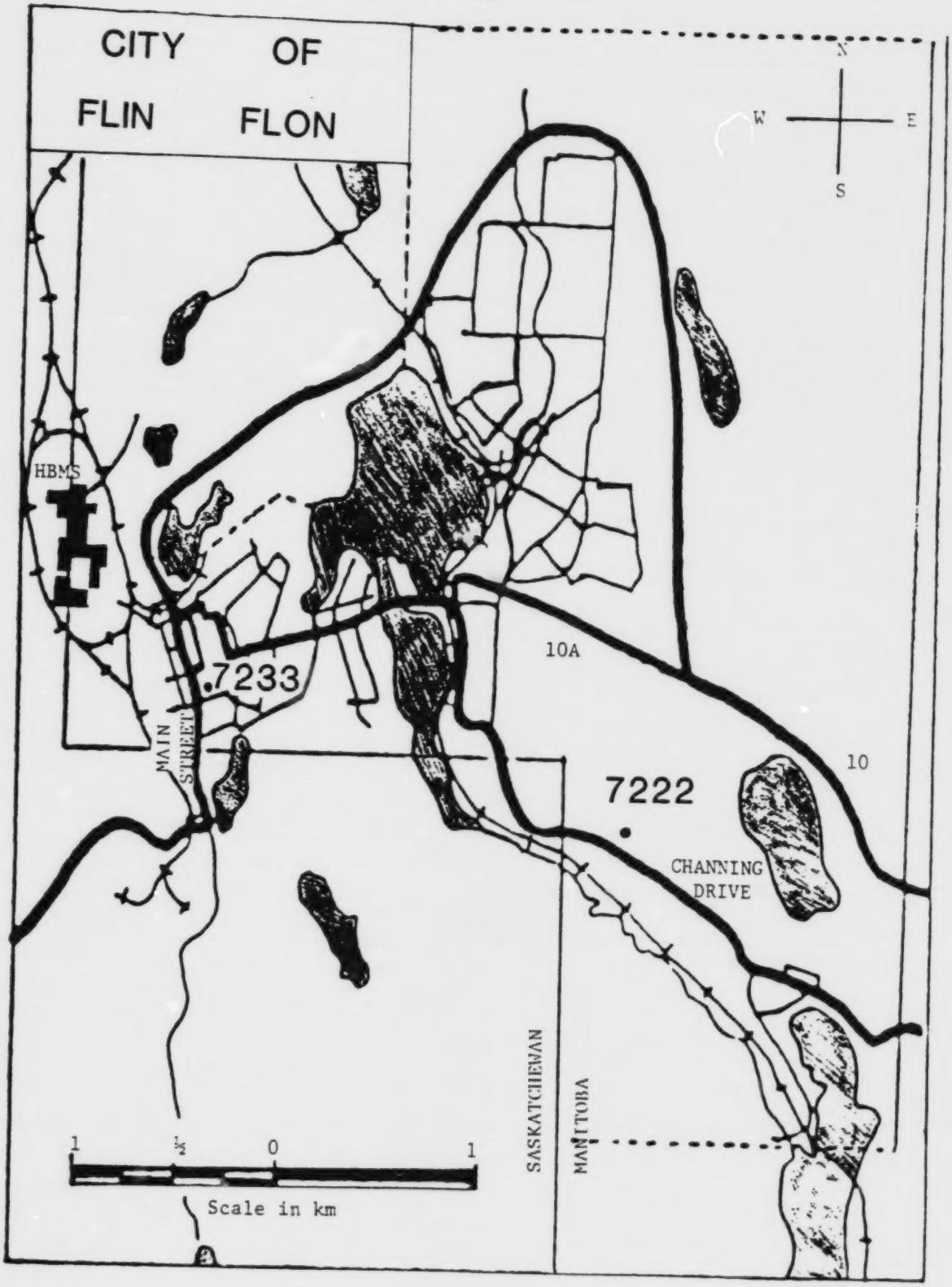
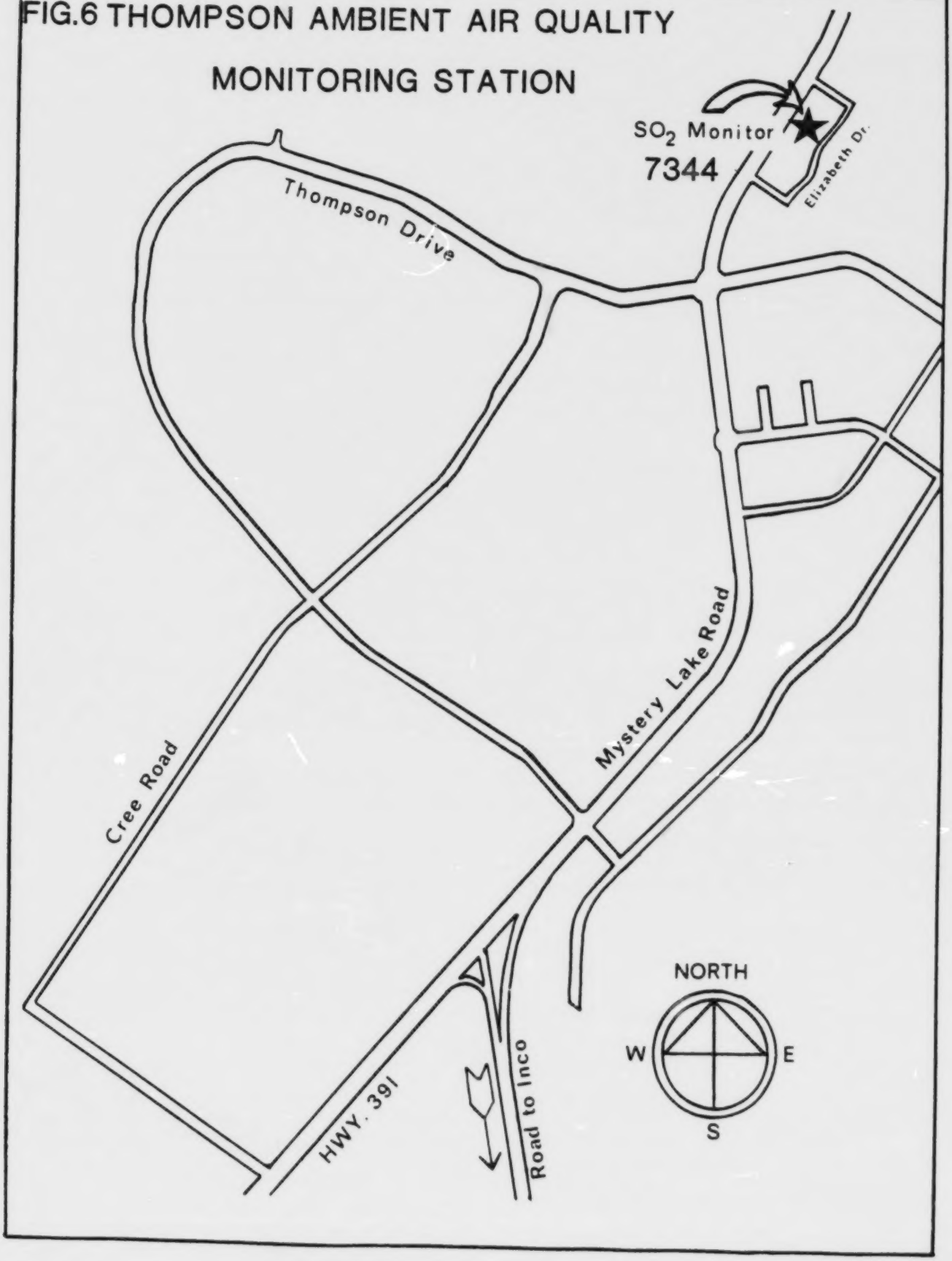

CITY OF
FLIN FLON
N
W
E
S
HBMS
7233
MAIN STREET
10A
10
7222
CHANNING DRIVE
SASKATCHEWAN
MANITOBA
1
½
0
1
Scale in km

FIGURE 5

FIG.6 THOMPSON AMBIENT AIR QUALITY MONITORING STATION



D) AIR QUALITY INDEX

A Canadian Annual Index of Air Quality has been developed and is used by several jurisdictions to report on air quality.

An air quality index transforms the values of individual air pollution related parameters into a single number or descriptive term in order to:

1. indicate air quality trends
2. permit comparisons of the air quality in different urban areas, and
3. provide a single value indicator of air quality for socio-economic modelling.

Determination of the Index

The concentrations of individual pollutants are converted to a common scale (the pollutant-index scale). The scale is designed such that a value of 0 corresponds to zero concentration, a value of 25 to a concentration equal to the Maximum Desirable Objective, a value of 50 to the Maximum Acceptable Objective, and a value of 100 to the Maximum Tolerable Objective. These points are joined by straight lines. When one or two of the objectives have not been specified for a particular pollutant and averaging time, or the concentration is outside the available objectives, the pollutant-index is determined by linear interpolation or extrapolation.

Using the scale generated above, the 98th percentile concentrations (concentrations exceeded only two (2) per cent of the time) are converted to pollutant-indices.

Where more than one pollutant-index has been computed for a given pollutant, the largest pollutant-index is used to represent that pollutant. The arithmetic mean of the three highest pollutant-indices is then calculated and used as the numerical value of the Canadian Annual Index of Air Quality. The air quality can also be described verbally according to the following scale:

Description	Numerical Values
GOOD	0 - 25
FAIR	26 - 50
POOR	51 - 100
VERY POOR	101 +

The following assumptions have been made in the design and use of this index:

1) The index will be based on valid air quality data from monitoring stations that meet the Class 1 requirements of the National Air Pollution Surveillance (NAPS) Network. A Class 1 air quality monitoring station is one where all air quality objective parameters (within reason) are measured continuously. These stations monitor air quality trends and thus require a certain permanency in operation and siting. They serve primarily to evaluate progress in the control of air pollution on a national basis and are fundamentally population oriented.
2) At the defined objective levels (Desirable, Acceptable and Tolerable), the effects of all pollutants have equal importance with respect to the quality of the air.

3) The index is based on the average of the three (3) different pollutants that have the most significant effect on the environment during a given year. This method was found to best represent actual quality and changes in air quality on an annual basis.

4) The index is based on the measured levels of air quality that are not exceeded more than two (2) per cent of the time as recommended by the World Health Organization.

Indices are only presented for stations 9118 (299 Scotia St., Winnipeg), and 9119 (65 Ellen St., Winnipeg) due to the Class 1 requirement.

The site specific indices are listed in Table 6.

RESULTS

EXPLANATION OF DATA STATISTICS

The summary statistics that appear on Tables 3 to 5 are designed to outline, in brief, a profile of annual air pollutant concentration levels at specific sites with comparison to Manitoba Air Quality criteria.

Each pollutant is addressed by name and a unique pollutant number. Immediately below the pollutant is the indication of the units in which the air pollutant concentration levels are reported. Each air sampling site is identified by a station number and location. More information on the specific sampling site can be found by referring to Table 2.

The quantity of data available from which the calculated statistics are drawn is indicated by the two following references:

"# of months of data" - this refers to the number of months in the year for which at least 75% of the data are valid and available (NOT applicable to non-continuous measurements such as TSP, Pb, sulphates, and nitrates).

"Percent of data available" - this refers to the percentage of unit data (e.g. hourly averages) per year that are valid and available.

These two statistics are reflective of representativeness of the data statistics for that year. To representatively reflect annual air quality, two months of each quarter and 75% of the total annual data should be available for statistical calculation.

The "Percentile Distribution" is the data distribution of the unit data as shown (i.e. hourly for most pollutants except bi-hourly for COH, 24-hour integrated samples for TSP, Pb, SO_4 and NO_3). The p^{th} percentile (e.g. 10%) is the pollutant concentration such that p% (e.g. 10%) of the data values are less than that indicated value of pollutant concentration and (100-p)% (e.g. 90%) is greater.

The annual mean is an arithmetic mean (unless otherwise shown) of the available unit data values. The maximum data values are the highest levels present or calculated for the time period listed within the shown year. Other than for the unit data, longer time-based averages are arithmetic and are running averages of consecutive unit data and can overlap for days and/or months. For example, 24-hour running samples are based on increments of one hour and could result in a maximum of 24 x 31 x 12 = 8928 24-hour sampling periods within a year. At least 75% of the data values within one running period must be available for the calculation of that running mean average.

A comparison of the data to the Manitoba Ambient Air Criteria (Table 1) is shown under the heading "# of samples above M.T.L"," ..... above M.A.L.", et al. This listing is a count of the number of time-based averages or unit data concentrations that are larger than the appropriate time-based objective or guideline level.

In Figures 7 to 25, monthly statistics of unit data for all pollutants (except for total suspended particulate and constituents) are plotted through the course of the year to provide a visual representation of key statistics such as monthly means, maximum concentrations, and 99th percentile concentration levels. In addition, objective and guideline levels are identified. Figures 26 to 49 illustrate actual measured levels of total suspended particulate matter (and constituents) through the course of the year.

TABLE 3:

MANITOBA AMBIENT AIR QUALITY DATA 1985 ANNUAL POLLUTANT SUMMARY

CARBON MONOXIDE (CO), #629
PARTS PER MILLION (PPM)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBTUION (1 HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1 HR	8 HR	# OF SAMPLES ABOVE M.D.L. 1 HR	8 HR	# OF SAMPLES ABOVE M.A.L. 1 HR	8 HR	# OF SAMPLES ABOVE M.T.L. 1 HR	8 HR
9118	WINNIPEG, SCOTIA & JEFFERSON	12	89.4	0.0	0.2	0.4	0.6	1.0	3.3	0.6	11.0	5.5	0	4	0	0		0
9119	WINNIPEG, 65 ELLEN STREET	12	85.7	0.3	0.5	0.7	1.0	1.6	3.6	0.9	14.6	10.5	3	25	0	0		0
9120	WINNIPEG, 604 ST. MARY'S ROAD	7	55.4	0.1	0.2	0.4	0.6	1.0	3.1	0.5	14.5	10.4	1	10	0	0		0

NITROGEN DIOXIDE (NO_2), #759
PARTS PER HUNDRED MILLION (PPHM)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1 HR	24 HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24 HR	# OF SAMPLES ABOVE M.A.L. 1 HR	24 HR	# OF SAMPLES ABOVE M.T.L. 1 HR.	24 HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	92.9	0.0	0.2	0.4	0.8	1.6	3.5	0.7	6.5	3.3						
9118	WINNIPEG, SCOTIA & JEFFERSON	12	87.1	0.0	0.0	0.2	0.9	2.0	4.3	0.7	9.5	4.2			0	0	0	
9119	WINNIPEG, 65 ELLEN STREET	12	66.1	0.5	1.1	1.7	2.4	3.3	4.9	1.8	9.5	4.9			0	0	0	
															0	0	0	

NITRIC OXIDE (NO), #769
PARTS PER HUNDRED MILLION (PPHM)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1 HR	24 HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24 HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24 HR	# OF SAMPLES ABOVE M.T.L. 1 HR.	24 HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	73.7	0.0	0.0	0.0	0.1	1.1	5.3	0.4	40.0	9.5						

OXIDANTS (OZONE) (O_3), #829
PARTS PER HUNDRED MILLION (PPHM)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.T.L. 1 HR	24 HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	13	92.9	1.2	2.3	3.0	3.6	4.6	6.0	3.0	8.1	5.6	458	8046	2	5782	0	
9118	WINNIPEG, SCOTIA & JEFFERSON	12	91.6	0.2	0.5	1.3	2.4	3.4	4.5	1.6	7.6	4.2	25	3967	0	1765	0	
9119	WINNIPEG, 65 ELLEN STREET	12	91.4	0.1	0.8	1.5	2.2	3.2	4.5	1.6	8.0	3.8	31	4082	0	903	0	
9120	WINNIPEG, 604 ST. MARY'S ROAD	8	61.4	0.3	1.6	2.5	3.2	4.1	5.7	2.4	7.0	4.6	140	4815	0	2274	0	

AMMONIA (NH_3), #789
PARTS PER MILLION (PPM)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1 HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24 HR	# OF SAMPLES ABOVE 3.0 PPM 1 HR.	# OF SAMPLES ABOVE M.A.L. 1 HR	24 HR	# OF SAMPLES ABOVE M.T.L. 1 HR	24 HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	91.7	0.0	0.0	0.0	0.0	0.0	1.3	0.0	6.7	1.4	12	37			

TABLE 4:

MANITOBA AMBIENT AIR QUALITY DATA 1985 ANNUAL POLLUTANT SUMMARY continued

HYDROGEN SULPHIDE (H_2S), #1619
PARTS PER BILLION (PPB)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1 HR	24 HR	# OF SAMPLES ABOVE M.D.L. 1 HR	24 HR	# OF SAMPLES ABOVE M.A.L. 1 HR	24 HR	# OF SAMPLES ABOVE M.T.L. 1 HR	24 HR
7111	THE PAS, PROVINCIAL BLDG.	12	70.9	0	0	0	0	0	3	0	40	4			10	0	0	

SULPHUR DIOXIDE (SO_2), #1629
PARTS PER MILLION (PPM)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1 HR	24 HR	# OF SAMPLES ABOVE M.D.L. 1 HR	24 HR	# OF SAMPLES ABOVE M.A.L. 1 HR	24 HR	# OF SAMPLES ABOVE M.T.L. 1 HR.	24 HR
9118	WINNIPEG, SCOTIA & JEFFERSON	9	82.7	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.01	0	0	0	0		0
9119	WINNIPEG, 65 ELLEN STREET	11	84.9	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.22	0.02	1	0	0	0		0
9120	WINNIPEG, 604 ST. MARY'S ROAD	4	30.7	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05	0.02	0	0	0	0		0
7233	FLIN FLON, CITY HALL	12	93.6	0.00	0.00	0.00	0.00	0.02	0.20	0.01	0.65	0.14	103	230	22	21		0
7222	FLIN FLON, CHANNING DRIVE	12	94.9	0.00	0.00	0.00	0.00	0.00	0.15	0.01	0.91	0.12	65	110	19	20		0
7344	THOMPSON, 59 ELIZABETH ROAD	12	91.9	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.68	0.18	59	112	21	37		0

SOILING INDEX (SMOKE), #9709
COEFFICIENT OF HAZE UNITS PER 1000 FEET (COH)

1985

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (2 HR SAMPLES) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 2 HR	24 HR	# OF SAMPLES ABOVE M.D.L. 2 HR	24 HR	# OF SAMPLES ABOVE M.A.L. 2 HR	24 HR	# OF SAMPLES ABOVE M.T.L 1 HR.	24 HR
9118	WINNIPEG, SCOTIA & JEFFERSON	12	84.3	0.0	0.0	0.0	0.1	0.1	0.4	0.1	0.9	0.5		0		0		
9119	WINNIPEG, 65 ELLEN STREET	12	85.8	0.0	0.1	0.1	0.2	0.3	0.8	0.2	2.6	0.9		5		0		
9120	WINNIPEG, 604 ST. MARY'S ROAD	8	58.6	0.0	0.0	0.0	0.1	0.1	0.3	0.0	0.8	0.4		0		0		

TOTAL SUSPENDED PARTICULATE (TSP), #1089
MICROGRAMS PER CUBIC METRE (ug/m^3)

1985

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24 HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24 HOUR	# OF SAMPLES ABOVE M.A.L. 24 HOUR	# OF SAMPLES ABOVE M.T.L. 24 HOUR
4304	ST. FRANCOIS XAVIER, MTS TRAILER (Background)	179	9	14	21	33	51	542	22	766	5	3
9102	WINNIPEG, 2120 PORTAGE AVENUE	53	17	31	44	57	101	191	42	220	3	0
9118	WINNIPEG, 299 SCOTIA STREET	95	16	23	32	47	69	236	33	573	5	1
9119	WINNIPEG, 65 ELLEN STREET	178	29	48	73	100	166	316	69	529	18	1
9120	WINNIPEG, 604 ST. MARY'S ROAD	36	23	33	46	68	106	144	46	153	2	0
9201	BRANDON, 1104 PRINCESS AVENUE	52	14	21	29	43	74	105	31	121	1	0

TABLE 5

MANITOBA AMBIENT AIR QUALITY DATA — ANNUAL POLLUTANT SUMMARY continued

LEAD (Pb), #8219
MICROGRAMS PER CUBIC METRE (ug/m^3)

1985

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HOUR	# OF SAMPLES ABOVE M.A.L. 24-HOUR
4304	ST. FRANCOIS XAVIER, MTS TRAILER (Background)	49	0.03	0.03	0.04	0.05	0.07	0.15	0.04	0.16	0
9102	WINNIPEG, 2120 PORTAGE AVENUE	54	0.07	0.13	0.18	0.23	0.30	0.39	0.16	0.40	0
9118	WINNIPEG, 299 SCOTIA STREET	51	0.05	0.07	0.10	0.12	0.16	0.22	0.09	0.24	0
9119	WINNIPEG, 65 ELLEN STREET	45	0.07	0.14	0.18	0.22	0.27	0.39	0.16	0.40	0
9120	WINNIPEG, 604 ST. MARY'S ROAD	36	0.08	0.11	0.14	0.18	0.25	0.33	0.14	0.33	0
9201	BRANDON, 1104 PRINCESS AVENUE	53	0.04	0.06	0.08	0.10	0.14	0.20	0.08	0.21	0

SULFATES (SO_4), #1639
MICROGRAMS PER CUBIC METRE (ug/m^3)

1985

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24 HOUR	# OF SAMPLES ABOVE M.A.L. 24-HOUR
4304	ST. FRANCOIS XAVIER, MTS TRAILER (Background)	29	0.6	0.9	1.2	1.9	3.0	5.2	1.2	5.2	
9102	WINNIPEG, 2120 PORTAGE AVENUE	53	0.9	1.2	1.6	2.3	3.4	5.6	1.7	6.7	
9118	WINNIPEG, 299 SCOTIA STREET	51	0.8	1.2	1.8	2.5	5.0	11.4	1.7	15.1	
9119	WINNIPEG, 65 ELLEN STREET	45	1.1	1.6	2.4	4.1	6.3	9.4	2.5	10.5	
9120	WINNIPEG, 604 ST. MARY'S ROAD	36	1.2	1.5	2.4	3.1	5.6	7.3	2.4	7.3	
9201	BRANDON, 1104 PRINCESS AVENUE	53	0.5	0.9	1.4	1.7	2.9	3.5	1.2	3.6	

NITRATES (NO_3), #0779
MICROGRAMS PER CUBIC METRE (ug/m^3)

1985

STATION NUMBER	STATION LOCATION	# OF SAMPLES	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HOUR	# OF SAMPLES ABOVE M.A.L. 24-HOUR
4304	ST. FRANCOIS XAVIER, MTS TRAILER (Background)	29	0.1	0.4	0.5	1.0	2.0	4.5	0.5	4.8	
9102	WINNIPEG, 2120 PORTAGE AVENUE	53	0.3	0.4	0.7	1.0	2.3	3.1	0.7	3.1	
9118	WINNIPEG, 299 SCOTIA STREET	51	0.1	0.3	0.6	1.0	2.5	3.1	0.6	3.2	
9119	WINNIPEG, 65 ELLEN STREET	45	0.2	0.5	0.9	1.4	2.5	3.7	0.7	3.9	
9120	WINNIPEG, 604 ST. MARY'S ROAD	36	0.3	0.5	0.8	1.4	2.3	3.5	0.8	4.1	
9201	BRANDON, 1104 PRINCESS AVENUE	52	0.2	0.3	0.4	0.7	1.6	2.1	0.4	2.3	

Table 6: 1985 Air Quality Indices

Station Code and Location	Pollutant	Averaging Time	98th %	Pollutant Index	Descriptor	Station Mean
9118	CO	1-hr.	2.4 ppm	4.7	Good	
299 Scotia St.	CO	8-hr.	2.0 ppm	9.6	Good	
Winnipeg	NO_2	1-hr.	3.7 pph	8.7	Good	
	NO_2	24-hr.	2.9 pphm	13.6	Good	
	O_3	1-hr.	4.3 pphm	21.5	Good	29.0
	TSP	24-hr.	134 $\mu g/m^3$	52	Poor	Fair
	SO_2	1-hr.	0.00 ppm	0	Good	
	SO_2	24-hr.	.34 pphm	0.5	Good	
9119	CO	1-hr.	2.9 ppm	5.7	Good	
65 Ellen St.	CO	8-hr.	2.3 ppm	11.2	Good	
Winnipeg	NO_2	1-hr.	4.3 pphm	10.1	Good	
	NO_2	24-hr.	3.6 pphm	16.9	Good	
	O_3	1-hr.	4.2 pphm	21.0	Good	38.0
	TSP	24-hr.	266 $\mu g/m^3$	76	Poor	Fair
	SO_2	1-hr.	0.01 ppm	1.5	Good	
	SO_2	24-hr.	.83 pphm	1.3	Good	

DISCUSSION

Though it was the intent within the design of the sampling network to locate monitoring sites in accord with generally-accepted siting criteria and to use collection and analytical procedures that are common to other networks, it should be noted that the data presented in this report may have limitations and, therefore, caution should be exercised towards its use. In particular, when comparing data between Canadian regions and even between stations in the same city, it must be realized that the data represents the condition of the air in the vicinity of the individual monitoring station and may not necessarily reflect community-wide air quality.

A. WINNIPEG AIR QUALITY

DOWNTOWN: The downtown monitoring station, 9119, at 65 Ellen Street measured levels of SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4, and NO_3.

Sulphur dioxide (SO_2) levels during 1985 at downtown Winnipeg continue to be low as in previous years at undetectable or trace concentrations. Only one excursion above the 1-hour Maximum Desirable Level (MDL) was recorded in 1985. This level was the maximum 1-hour data value of 0.22 ppm recorded on February 09. The maximum 24-hour value was 0.02 ppm SO_2.

Carbon monoxide (CO) levels at station 9119 appear higher than those at residential site 9118 but similar to 9120 (Table 3 and

Figures 7, 8 and 9). Further, levels are similar to those measured at this site during 1984. The MDL criteria were exceeded at this site during the early spring and late fall time periods; it is uncertain as to the specific cause of these levels. The maximum 1-hour and 8-hour data levels were 14.6 and 10.5 ppm, respectively.

Nitrogen dioxide (NO_2) levels at this site continue to be well below the Manitoba Air Quality objectives. No values above the 1-hour Maximum Acceptable Level, MAL (0.213 ppm) nor the 24-hour MAL (0.106 ppm) were recorded. The maximum values recorded were 0.095 ppm for one hour and 0.049 for twenty-four hours; these levels are similar to those observed in 1984.

Ozone (O_3) levels in downtown Winnipeg appear similar to those levels measured at site 9118 but lower than at the other residential site (9120) and Brandon; however, maximum 1-hour levels appear to be similar across all sites. No levels were above the 1-hour MAL though frequent excursions continue to be measured above the 1-hour MDL and both the 24-hour MDL and MAL. The maximum 1-hour ozone value was 0.08 ppm and the maximum 24-hour value was 0.038 ppm.

Soiling index values as measured by Coefficient of Haze (COH) units per 1000 feet are again higher downtown than at the two residential stations (Table 4). There were 5, 24-hour average readings above the MDL of 0.45, but none above the MAL of 1.0. All five excursions occurred during the last two days of November; again, no specific incident can be associated with these levels. The maximum 2-hour value recorded was 2.6 COH units and the maximum 24-hour value was 0.9 COH units. These maximums are very similar to the highest levels recorded in 1984.

Downtown Winnipeg total suspended particulate (TSP) levels, as during previous years, were the highest of all sites. The annual geometric mean of 69 $\mu g/m^3$ is above the MDL (60 $\mu g/m^3$ but below the MAL level (70 $\mu g/m^3$). The maximum 24-hour TSP value was 529 $\mu g/m^3$, on June 8, 1985, when visibilities were reduced to 1 kilometre by blowing dust from near gale force winds (Environment Canada); all other Winnipeg sites recorded elevated levels on this day. This was the only reading to exceed the 24-hour Maximum Tolerable Level (MTL). Of the 178 days sampled for TSP at this site, 38 (21%) exceeded the 24-hour MAL. The sampling frequency for TSP was increased at this site during the months March to October to better assess air quality during months where elevated levels have been observed in previous years.

Lead (Pb) levels at station 9119 and at all the other stations where Pb is monitored do not approach the MAL of 5.0 micrograms per cubic metre of air as a 24-hour average. Downtown Winnipeg does have the highest average and maximum individual lead levels (0.16 and 0.40 $\mu g/m^3$ respectively).

Sulphate ($SO_4^=$) levels at downtown Winnipeg had an annual average of 2.5 $\mu g/m^3$ as a 24-hour average with a maximum of 10.5. These levels are similar to previous years. There are no Manitoba Air Quality Guidelines nor Objectives for sulphates.

Nitrate (NO_3^-) concentrations at all Winnipeg stations are similar. The annual mean at station 9119 is 0.7 $\mu g/m^3$ with a maximum data level of 3.9 $\mu g/m^3$. As with sulphates, there are no Manitoba Air Quality Guidelines nor Objectives for nitrates.

Based on the Canadian Annual Air Quality Index, air quality in downtown Winnipeg is rated as being FAIR, with a pollutant index value of 38 (Table 6). During both 1983 and 1984, air quality was also rated as fair. The main contribution to the FAIR ratings during all years was 24-hour total suspended particulate levels; all other pollutant sub-indices fall within the good range.

RESIDENTIAL: The description of Winnipeg residential air quality is based on sampling conducted at station 9118 (299 Scotia Street) and at the second residential site 9120 (604 St. Mary's Road). Sampling at 9120 terminated in August 1985 due to program streamlining; more emphasis should be placed on results from 9118 since a complete year of data is available.

Sulphur dioxide (SO_2) concentrations at both of the residential sites (9118 and 9120) are well below ambient air quality objectives and are usually undetectable or at trace levels. The maximum 1-hour levels were about 0.04 ppm with the maximum 24-hour level in the 0.01 to 0.02 ppm range. Levels are similar to those measured in previous years. In general, sulphur dioxide levels in Winnipeg air are near background levels.

Carbon monoxide levels at 9118 and 9120 have similar annual means (0.5-0.6 ppm) and are lower than those in the downtown area. Maximum 1-hour and 8-hour concentrations at 9120 are similar to those in the downtown area (14.5 and 10.4 ppm respectively) whereas levels at 9118 are 11.0 and 5.5 ppm, respectively. Station 9120 had 1 excursion of the 1-hour MDL and 10 above the 8-hour MDL; none of these

levels exceeded the MAL criteria. At 9118, only 4 excursions of the 8-hour MDL were recorded. The somewhat higher CO levels at 9120 can be accounted by its closer distance to a major traffic artery where automobile emissions of CO occur.

Nitrogen dioxide (NO_2) levels were measured only at the 9118 site; levels appear to be very similar to those in the downtown area. The maximum 1-hour level recorded was 0.095 ppm and the maximum 24-hour was 0.042 ppm. All values were below the MAL criteria.

Ozone (O_3) levels at the St. Mary's Road site (9120) appear to be somewhat higher than those at the Scotia Street location. This observation is similar to that noted in evaluation of the 1984 data. The 1-hour MAL was not exceeded at either of the two sites. However, frequent excursions above the 1-hour MDL and the 24- hour criteria occur similar to downtown Winnipeg and Brandon. At station 9120 the maximum O_3 values were 0.070 (1-hour) and 0.046 ppm (24-hour); at station 9118 the maximums were 0.076 ppm (1-hour) and 0.042 ppm (24-hour).

Soiling Index (COH) values at both of the residential sites are similar to each other and lower than those at the downtown area. There were no levels above the 24-hour MDL nor MAL. The maximum 2-hour levels were 0.8-0.9 COH per 1000 feet with the maximum 24-hour readings in the 0.4 to 0.5 range.

Total suspended particulate (TSP) matter levels at 9120 are somewhat higher than those at 9118 (annual means 46 and 33 $\mu g/m^3$, respectively) but both sites appear to be lower than the downtown area. The maximum 24-hour reading at 9118 was 573 $\mu g/m^3$ recorded

on June 08 during the dust storm; this was the only reading to exceed the 24-hour MTL. Sampling was not conducted on this date at 9120 and therefore the maximum of the year was only 153 $\mu g/m^3$. Of the 95 daily samples gathered at 9118, only 5 (5%) exceeded the 24- hour MAL. At 9120, two of the thirty-six (or 6%) samples exceeded the 24-hour MAL. As shown in Figures 26 and 29, it can be seen that the higher TSP levels usually occur during the spring/summer seasons. The sampling frequency at 9118 for TSP was similar to that at 9119 (increased sampling during March to October) whereas 9120 was sampled at the standard once every sixth day NAPS cycle.

Lead (Pb) levels at 9118 and 9120 are lower than at the downtown site (9119), though levels at 9120 are somewhat higher than those at 9118. All levels at both of the residential sites were well below the MAL of 5.0 $\mu g/m^3$. The maximum data value at station 9118 was 0.24 $\mu g/m^3$ and at station 9120 the maximum was 0.33 $\mu g/m^3$.

Sulphate ($SO_4^=$) and nitrate (NO_3^-) concentrations at both of the residential sites are generally similar to concentrations at the downtown site. No air quality guidelines have been promulgated for comparison.

Winnipeg residential air quality as measured at station 9118 rates a Pollutant Index value of 29.0 or FAIR. This is the same rating as in 1984. As at the downtown site, total suspended particulate levels contribute significantly to the overall fair rating. No index is calculated for 9120 because of the incomplete database for the year.

ROADSIDE: Air quality in the vicinity of areas with high density traffic is represented by data from station 9102 where monitoring was conducted for TSP, Pb, SO_4^-, and NO_3^-.

Total suspended particulate (TSP) levels at 9102 are similar to those measured at the 9120 residential site but are lower than the downtown area. The annual geometric average of 42 $\mu g/m^3$ is below both the annual MDL and MAL. The maximum 24-hour level was recorded on March 2 (220 $\mu g/m^3$); no sampling was conducted on the June 08 dust storm. Of the 53 samples collected, 3 (6%) exceeded the 24-hour MAL. The sampling frequency at this site is the once per sixth day NAPS cycle.

Lead (Pb) levels at this site located along Portage Avenue (a busy multi-lane traffic artery) were very similar to those encountered in the downtown area. The annual geometric mean was 0.16 $\mu g/m^3$ with an individual daily maximum of 0.40 $\mu g/m^3$. However, all levels are well below the Manitoba air quality guideline for lead.

Sulphates and nitrates at 9102 were similar to those at the other Winnipeg stations (Table 5).

BACKGROUND: Background levels of TSP (and constituents analysis for lead, sulphates and nitrates) are monitored at station 4304 (St. Francois Xavier) a small hamlet located approximately 7 kilometres west from Winnipeg's city limits. TSP levels at this site showed a lower annual mean (22 $\mu g/m^3$) than all Winnipeg sites (46 $\mu g/m^3$) thus implying that about a half of the particulate matter observed in the city could originate from the rural area and be

natural background and/or originates from agricultural fields. However, the maximum 24-hour level measured at 4304 was 766 $\mu g/m^3$ on May 05 (gusty winds present). Besides the June 08 dusty day (539 $\mu g/m^3$), another high level was also recorded (554 $\mu g/m^3$ on May 03). The above three days were those that exceeded the 24- hour MTL. Additionally, 5 (39%) of the 179 sampling days exceeded the 24-hour MAL. The increased sampling frequency at this site was similar to that at the downtown Winnipeg site (9119).

Lead (Pb) levels at 4304 were significantly lower than those measured in Winnipeg. The annual mean was 0.04 $\mu g/m^3$ compared to the Winnipeg overall mean (all sites) of 0.13 $\mu g/m^3$. The maximum 24-hour level recorded at 4304 was 0.16 $\mu g/m^3$. All measurements were well below the MAL for lead.

Sulphates and nitrates at the background site, on average, are lower than those at the Winnipeg stations. The annual average for sulphates was 1.2 $\mu g/m^3$ compared to the Winnipeg average of 2.0 $\mu g/m^3$; similarly the background nitrate level was 0.5 $\mu g/m^3$ compared to the Winnipeg average of 0.7 $\mu g/m^3$.

B. BRANDON AIR QUALITY

DOWNTOWN: Air quality in downtown Brandon is monitored at station 9201 (1104 Princess Avenue) for the selected parameters of TSP, Pb, $SO_4^=$, and NO_3^-. TSP levels at this site are similar to those in the Winnipeg residential area (Figures 26, 29 and 31). The annual average of 31 $\mu g/m^3$ is significantly lower than that

recorded in 1984 (41 $\mu g/m^3$). The maximum 24-hour level was 121 $\mu g/m^3$ recorded on August 29; this level was the only sample out of the 52 sampling days that exceeded the 24- hour MAL of 120 $\mu g/m^3$.

Lead (Pb) levels in downtown Brandon are similar to those in the residential area of Winnipeg. The maximum 24-hour level was 0.21 $\mu g/m^3$ with an annual mean of 0.08 $\mu g/m^3$; all readings are well below the Provincial air quality guideline of 5.0 $\mu g/m^3$.

Sulphate and nitrate levels in downtown Brandon are similar to those measured at St. Francois Xavier (4304).

INDUSTRIAL: Air quality in the east industrial part of Brandon is monitored at station 5131 for the parameters $NO-NO_2-NO_x$, O_3, and NH_3. The monitoring station is located on the grounds of the Assiniboine Community College.

Nitrogen dioxide (NO_2) levels at station 5131 are slightly lower than those measured at the Winnipeg stations (9118, 9119). No values exceeded the MAL criteria. The maximum data values at this location were 0.065 ppm (1-hour) and 0.033 ppm (24-hour). Nitric oxide (NO) concentrations were also monitored at station 5131 although no Manitoba Air Quality Guidelines or Objectives have been formulated. The annual mean was 0.004 ppm with maximum values of 0.40 ppm (1-hour) and 0.095 ppm (24-hour).

Ozone (O_3) levels at station 5131 are higher than those found at the three Winnipeg sites; this has been observed for several years and hints on the regional background nature of ozone since Brandon is basically a non-industrial community located in a rural

agricultural area. Two hours exceeded the 1-hour MAL. Frequent exceedences were recorded above the 1-hour MDL and the 24- hour time-based criteria. The maximum data values were 0.081 ppm (1-hour) and 0.056 ppm (24 hour).

Ammonia (NH_3) monitoring at station 5131 is emission source-specific since the monitoring location is in the vicinity of a chemical company which produces and uses ammonia in the production of agricultural fertilizers. Background levels of ammonia are undetectable; the vast majority of monitored levels are undetectable and reported as being 0.0. The maximum recorded levels at this site were 6.7 ppm 1-hour and 1.4 ppm 24-hour time period. The Manitoba MAL guideline of 2.0 ppm ammonia for any one hour period was exceeded 37 times. The existing Manitoba Government Clean Environment Commission regulatory limit issued to the fertilizer company of 3.0 ppm as a 1-hour average was exceeded on 12 occasions. In comparison to levels of ammonia measured in 1984, levels in 1985 appear to have decreased, in general, even though maximum levels are similar.

C. THE PAS AIR QUALITY

Hydrogen sulphide (H_2S) is the only air quality parameter measured in The Pas. The H_2S monitor is located in the Provincial Building at the intersection of 3rd Street and Ross Avenue in the downtown area. The primary source of H_2S in the community is a kraft pulp and paper mill located approximately 5 kilometres NE from

the town. Annual emissions of total reduced sulphur compounds is estimated to be about 1 kilotonne per year (Schultz, 1987). H_2S levels recorded by the monitor are normally undetectable (<3 ppb) and are reported as 0.0. During 1985, there were 10 one-hour values above the MAL of 11 ppb but no averages calculated to be above the 24-hour MAL of 4 ppb. The maximum data values were 40 ppb 1-hour and 4 ppb as a 24-hour average.

D. FLIN FLON AIR QUALITY

Sulphur dioxide is monitored in Flin Flon by the Province at two locations: a) Site 7233 located in downtown Flin Flon at 35 Main Street, and b) Site 7222 located at Channing Drive near the outskirts of town. The primary source of SO_2 in Flin Flon is a major zinc-copper smelter located in the downtown area which had reported SO_2 emissions of 270, 239 tonnes in 1985 (Jackson et al, 1987). In addition, three monitoring sites are operated and reported on by the above Company.

Sulphur dioxide levels measured at both of the Provincial sites appear to be similar to one another unlike previous years where levels at the downtown area have appeared to be higher (Regehr, 1985). As would be expected about an individual source, most hourly levels are undetectable and reported to be 0.00. The annual average at both sites was 0.01 ppm. At the downtown site (7233), 22 1-hour averages and 21 24-hour averages were above the MAL criteria. A somewhat higher frequency above the MDL criteria was observed. At the

Channing site (7222), 19 1-hour and 20 24-hour levels were recorded above the MAL criteria. Levels above the MDL criteria were somewhat more frequent than those above the MAL criteria but lower than those at 7233. In comparison to 1984, a higher exceedence frequency was observed for both sites and for all criteria.

The maximum data values downtown (7233) were 0.65 ppm (1-hour) and 0.14 ppm (24-hour) and at Channing (7222), the maximum values were 0.91 ppm (1-hour) and 0.12 ppm (24-hour). These maximum values are similar to those observed at these same sites in 1984.

E. THOMPSON AIR QUALITY

Sulphur dioxide (SO_2) is the only pollutant monitored in Thompson by the Province. The one site (7344) is located within the Thompson Provincial Building (59 Elizabeth Road) at a distance of about 2.9 kilometres from a major nickel-copper smelter located south of the town. Reported SO_2 emissions from this complex during 1985 were 188,583 tonnes (Jackson et al, 1987). An additional air monitoring station to measure SO_2 is also maintained by the Company within the City of Thompson.

During 1985, 21 1-hour and 37 24-hour averages were recorded above the Provincial MAL criteria. A somewhat higher frequency of exceedences above the MDL criteria were observed. The maximum data levels were 0.68 ppm (1-hour) and 0.18 ppm (24-hour). SO_2 levels during 1985 were nearly identical to those observed and reported in 1984 (Regehr, 1985).

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Schultz, A. Manitoba Environment and Workplace Safety and Health. Private communication. 1987.

APPENDIX

Fig. 7 CARBON MONOXIDE (CO) 1–HR. SAMPLES

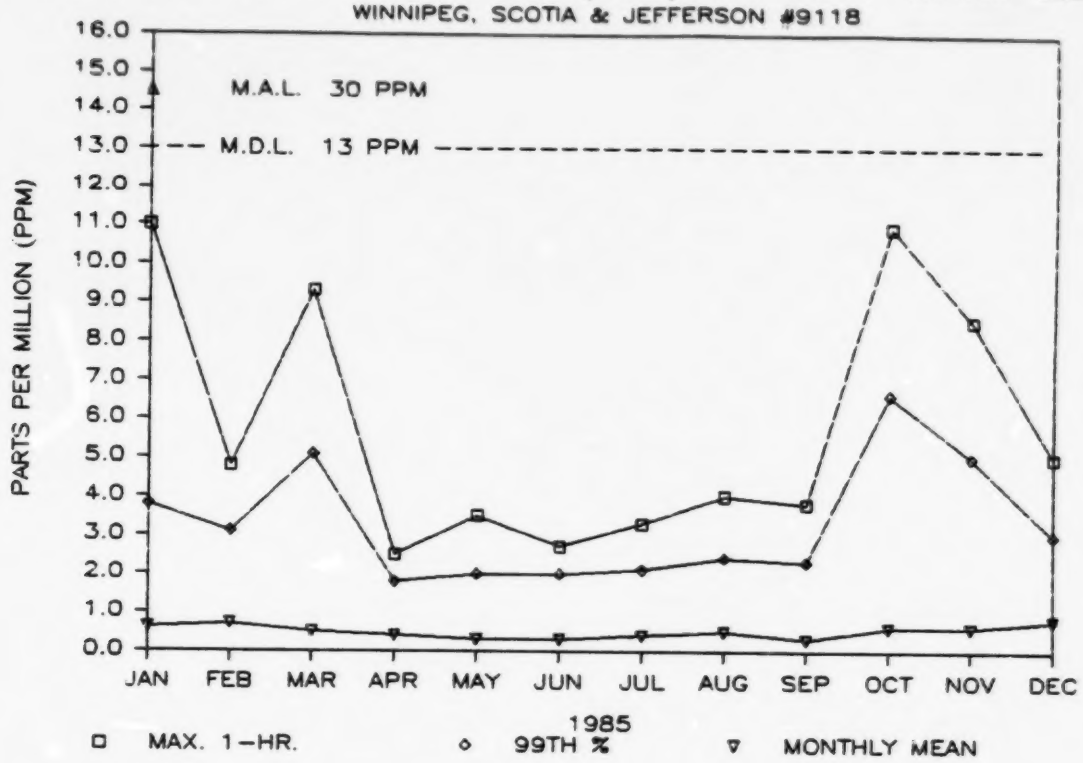


Fig. 8 CARBON MONOXIDE (CO) 1–HR. SAMPLES

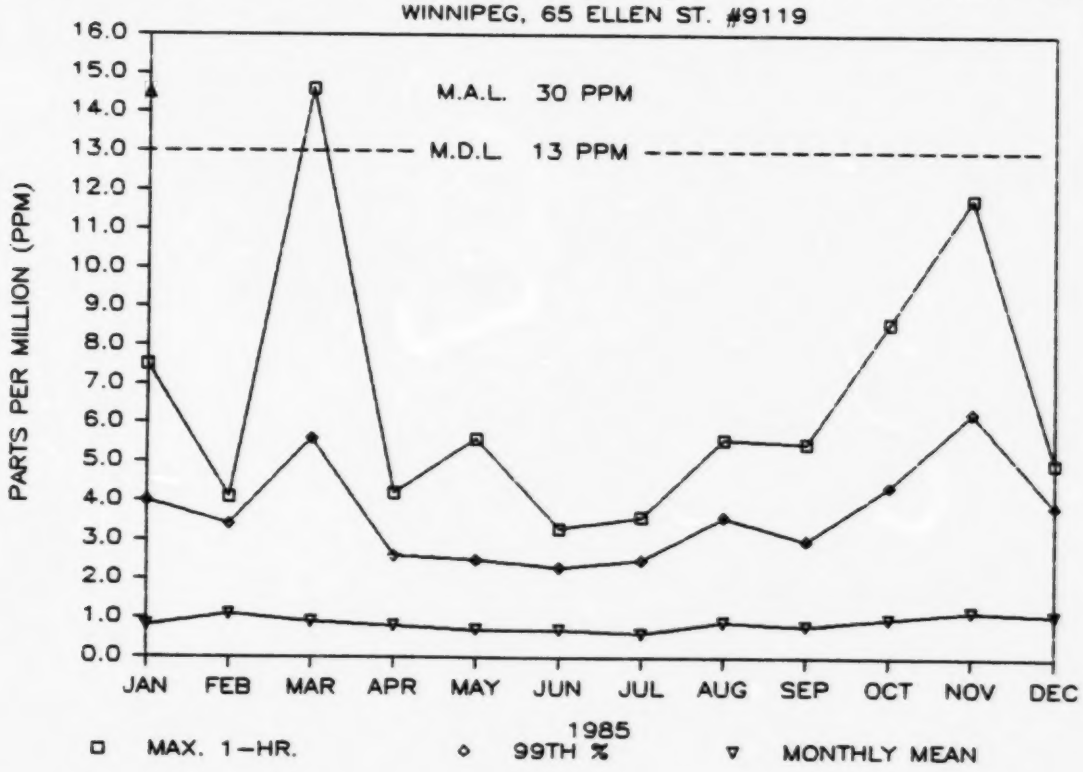


Fig. 9 CARBON MONOXIDE (CO) 1–HR. SAMPLES

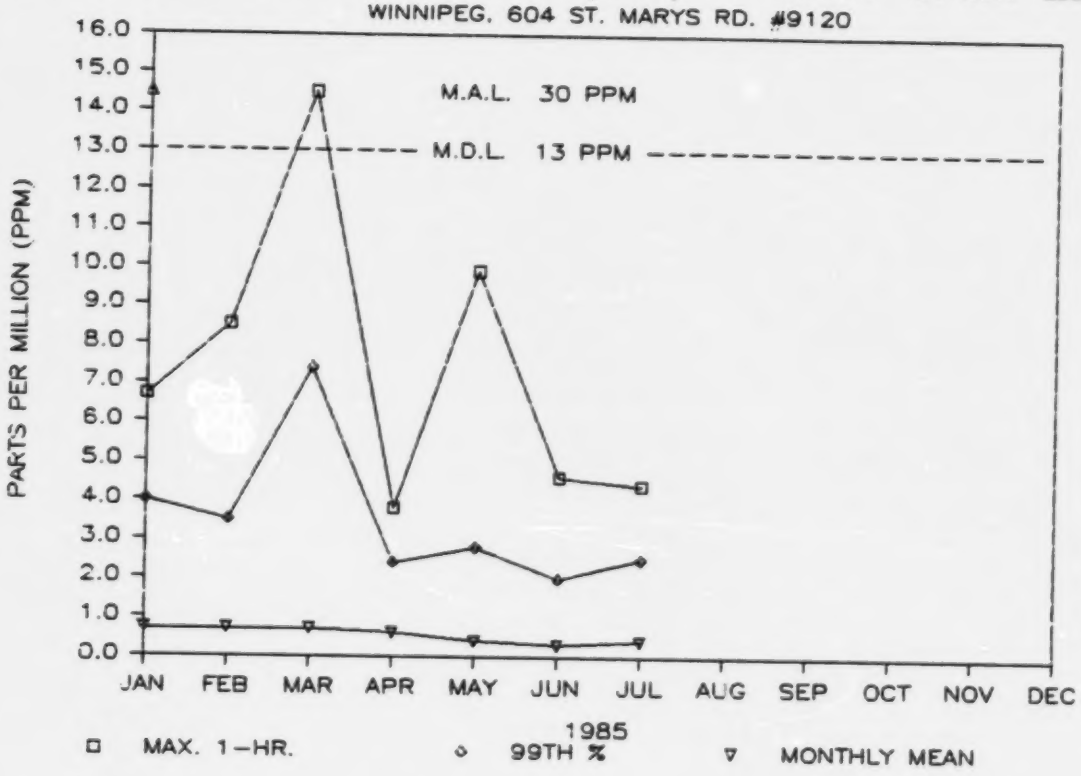


Fig. 10 NITROGEN DIOXIDE (NO2) 1–HR. SAMPLES

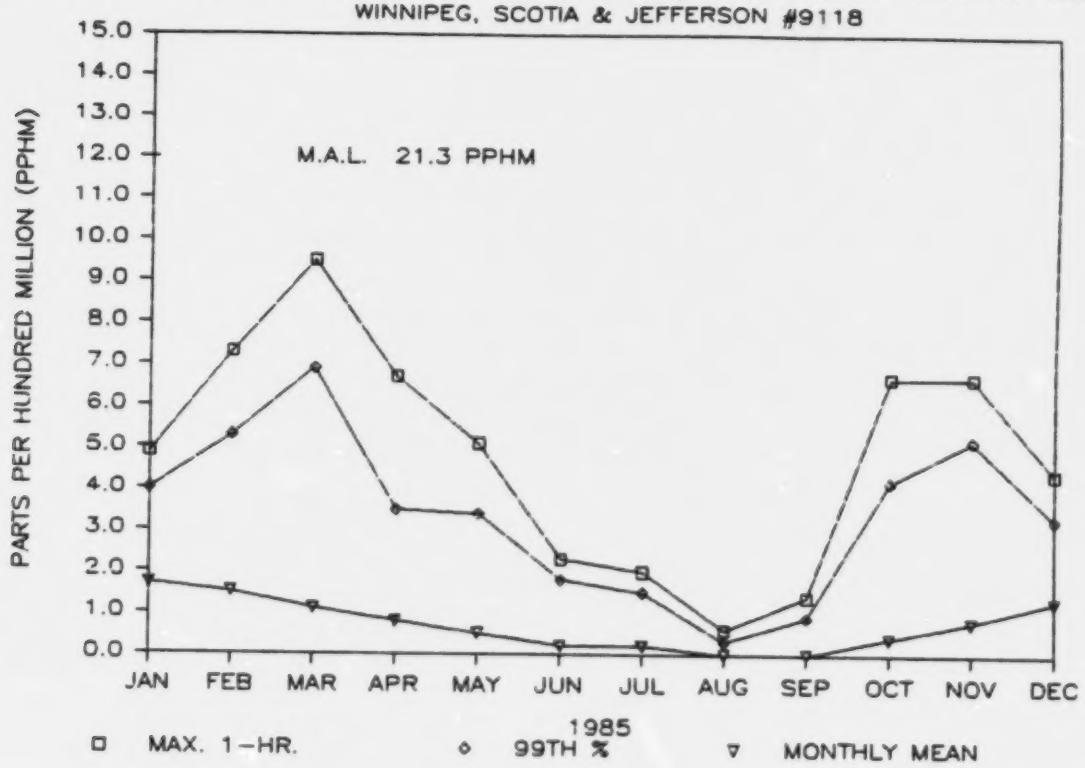


Fig. 11 NITROGEN DIOXIDE (NO2) 1–HR. SAMPLES

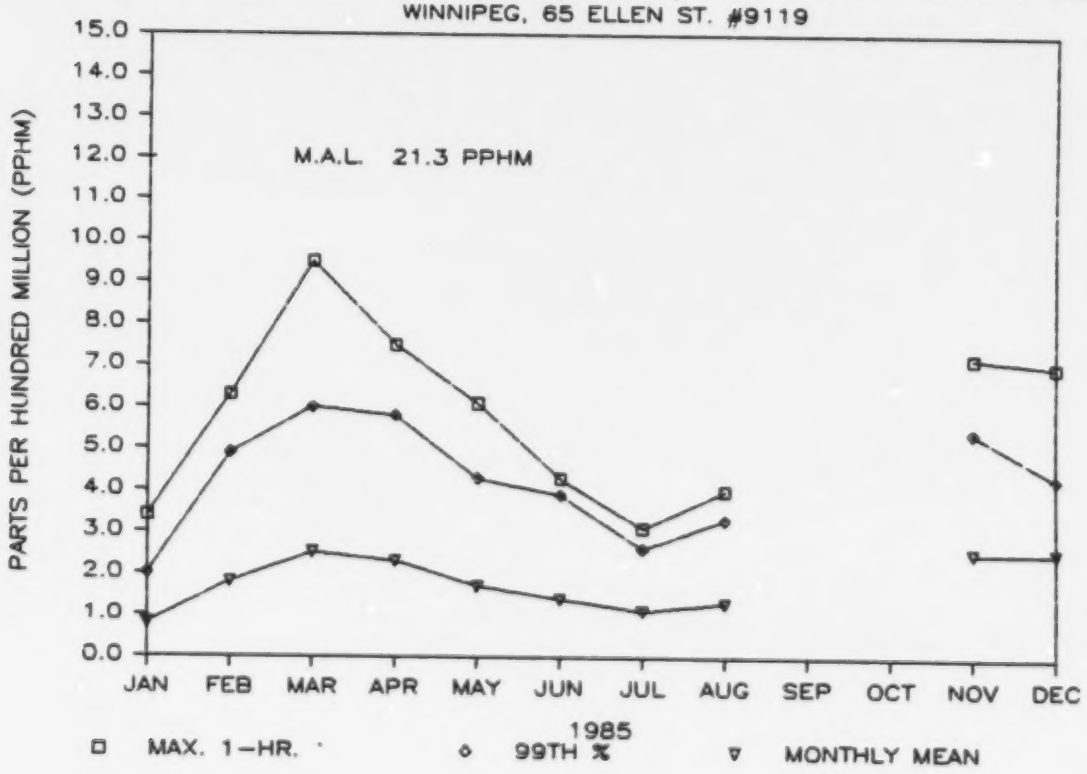


Fig. 12 NITROGEN DIOXIDE (NO2) 1-HR. SAMPLES

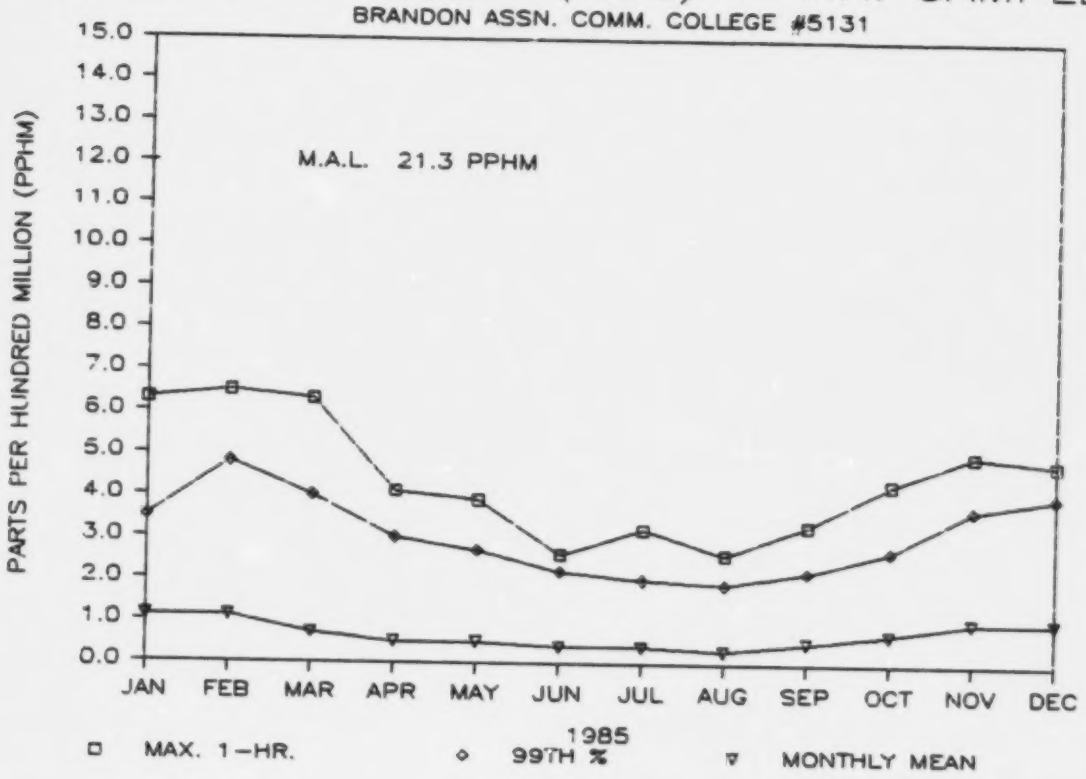


Fig. 13

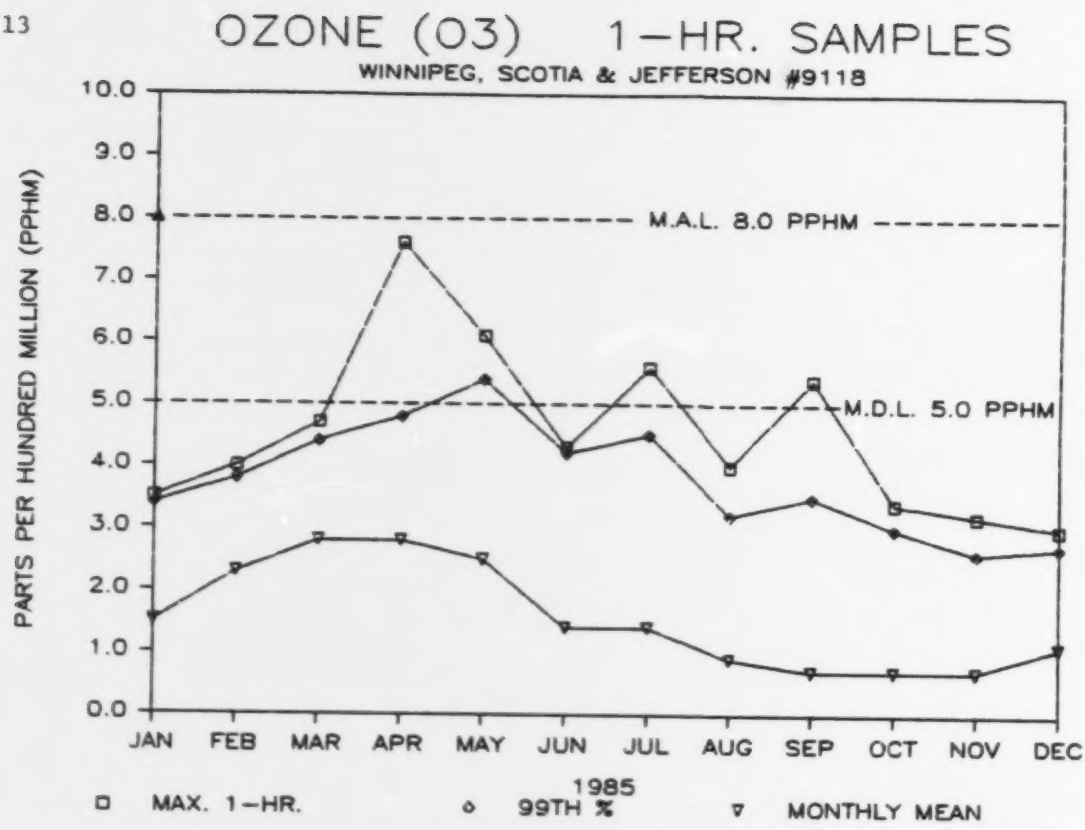

OZONE (O3) 1-HR. SAMPLES
WINNIPEG, SCOTIA & JEFFERSON #9118
PARTS PER HUNDRED MILLION (PPHM)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
M.A.L. 8.0 PPHM
M.D.L. 5.0 PPHM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 1-HR.
99TH %
MONTHLY MEAN

Fig. 14

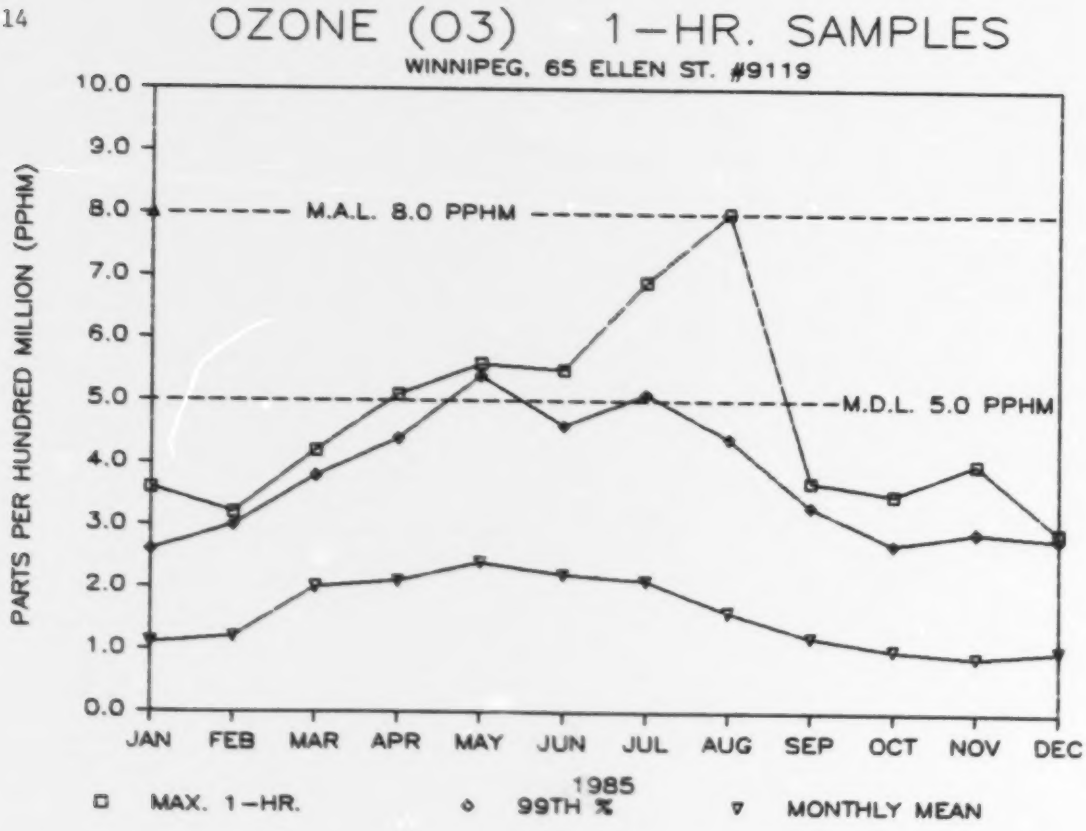

OZONE (O3) 1-HR. SAMPLES
WINNIPEG, 65 ELLEN ST. #9119
PARTS PER HUNDRED MILLION (PPHM)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
M.A.L. 8.0 PPHM
M.D.L. 5.0 PPHM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 1-HR.
99TH %
MONTHLY MEAN

Fig. 15

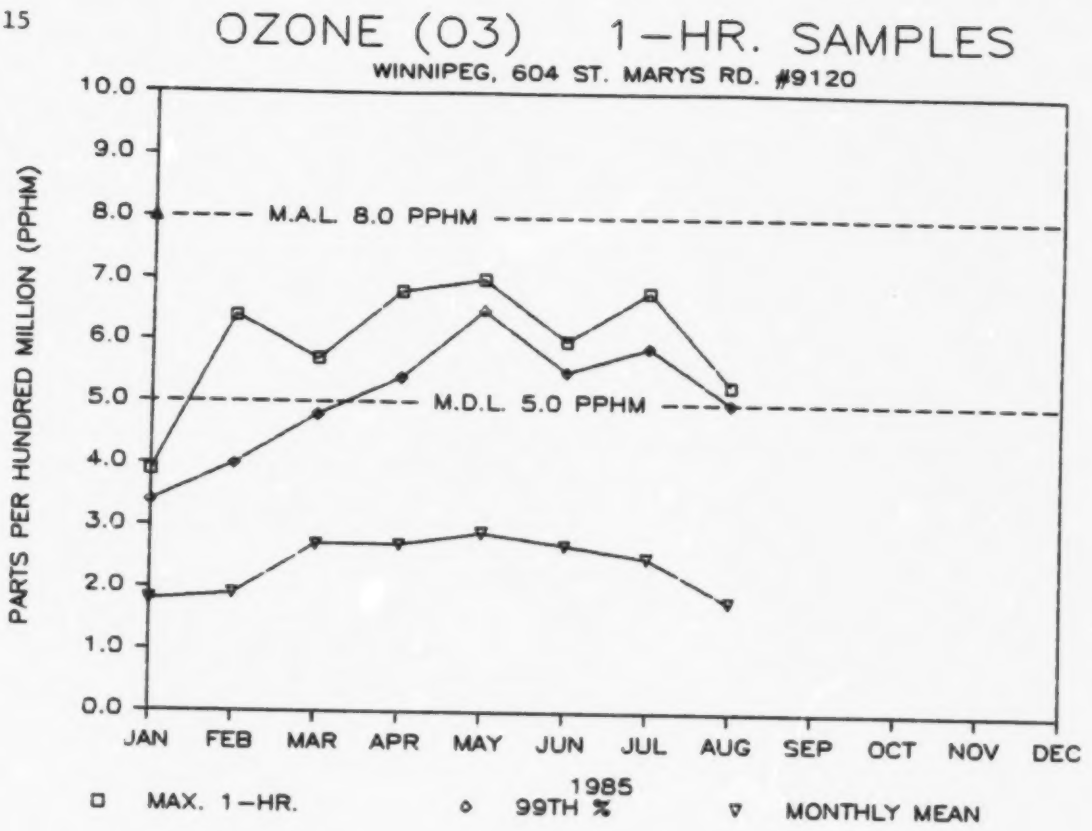

OZONE (O3) 1-HR. SAMPLES
WINNIPEG, 604 ST. MARYS RD. #9120
PARTS PER HUNDRED MILLION (PPHM)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
M.A.L. 8.0 PPHM
M.D.L. 5.0 PPHM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 1-HR.
99TH %
MONTHLY MEAN

Fig. 16

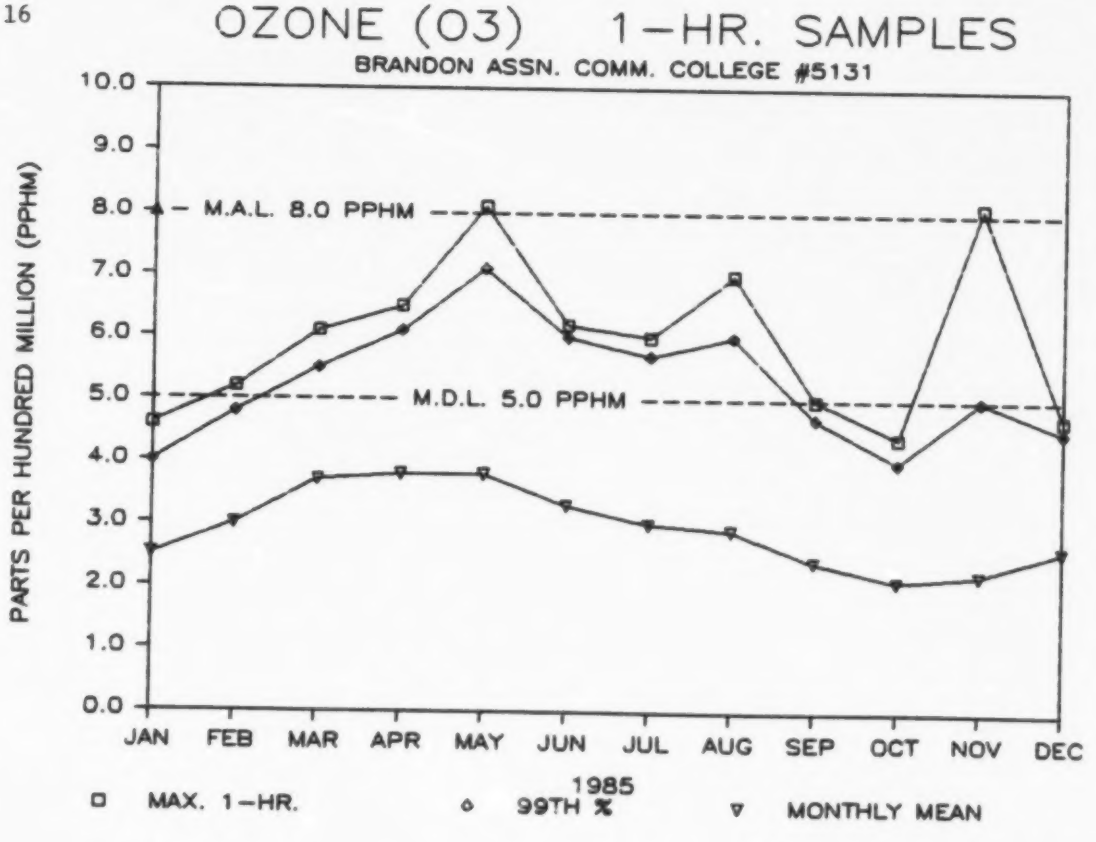

OZONE (O3) 1-HR. SAMPLES
BRANDON ASSN. COMM. COLLEGE #5131
PARTS PER HUNDRED MILLION (PPHM)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
M.A.L. 8.0 PPHM
M.D.L. 5.0 PPHM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 1-HR.
99TH %
MONTHLY MEAN

Fig. 17

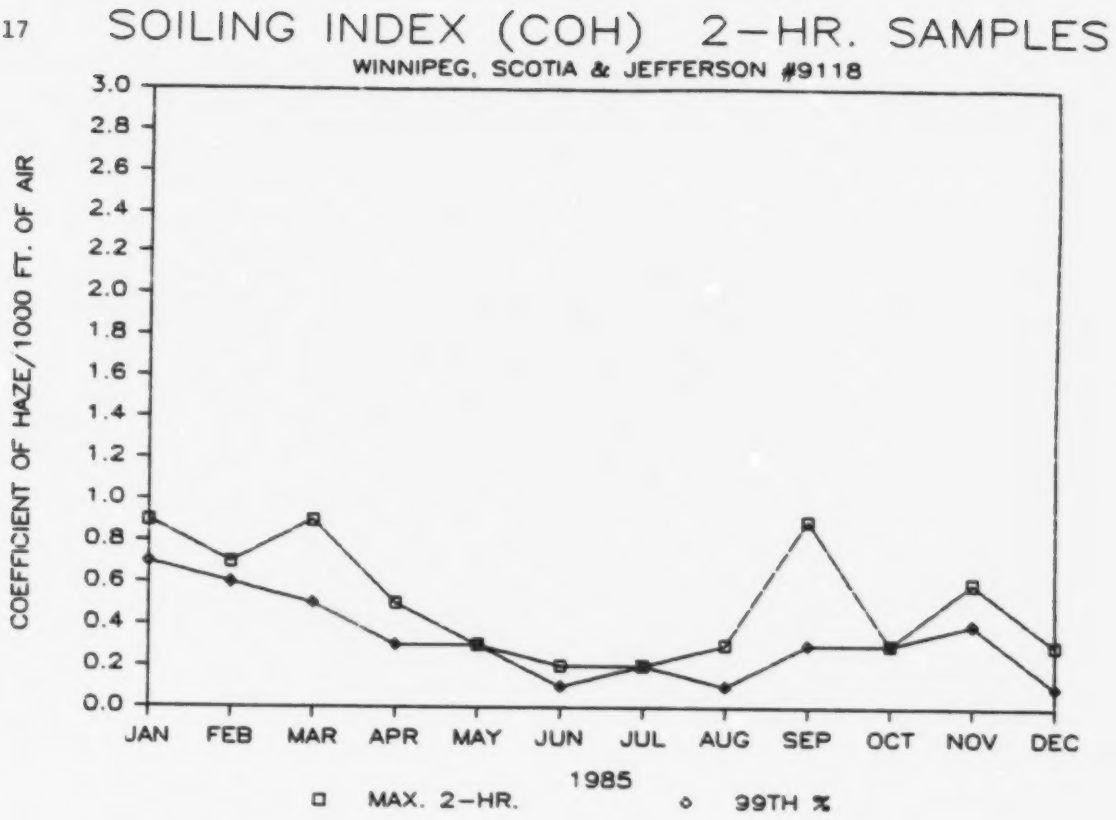

SOILING INDEX (COH) 2-HR. SAMPLES
WINNIPEG, SCOTIA & JEFFERSON #9118
COEFFICIENT OF HAZE/1000 FT. OF AIR
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 2-HR.
99TH %

Fig. 18

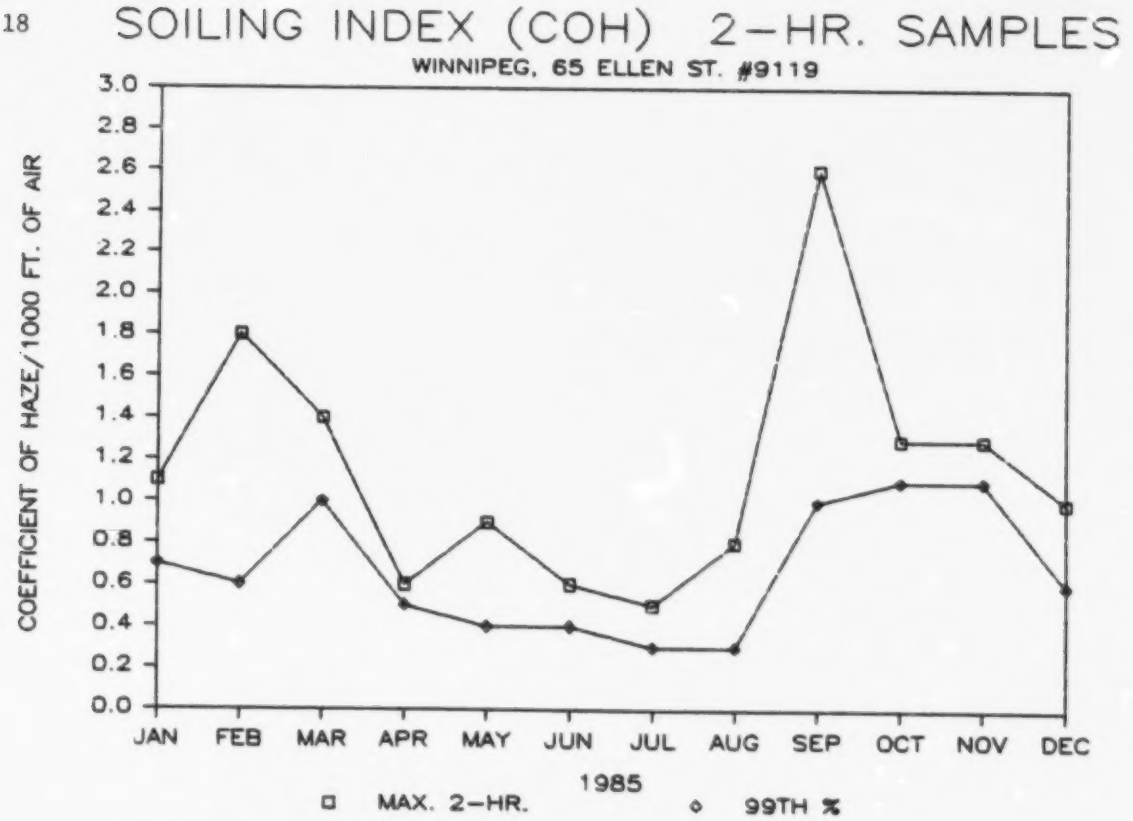

SOILING INDEX (COH) 2-HR. SAMPLES
WINNIPEG, 65 ELLEN ST. #9119
COEFFICIENT OF HAZE/1000 FT. OF AIR
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 2-HR.
99TH %

Fig. 19

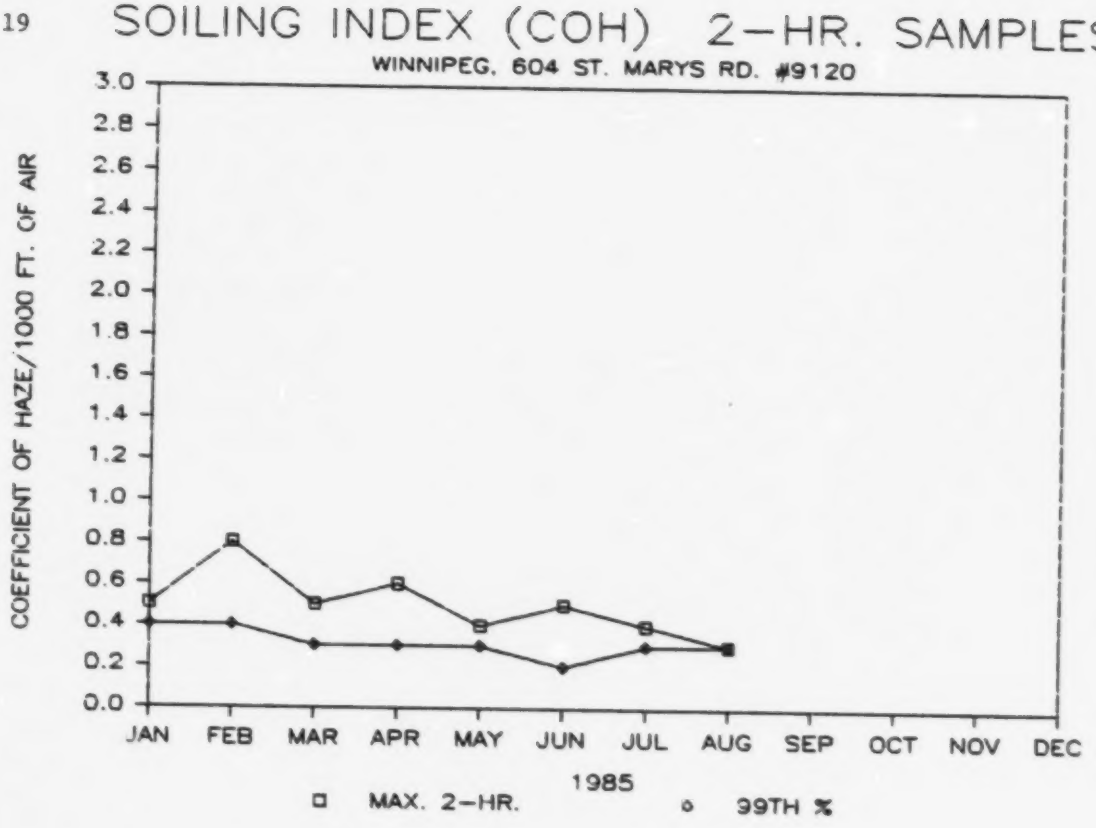

SOILING INDEX (COH) 2-HR. SAMPLES
WINNIPEG, 604 ST. MARYS RD. #9120
COEFFICIENT OF HAZE/1000 FT. OF AIR
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 2-HR.
99TH %

Fig. 20

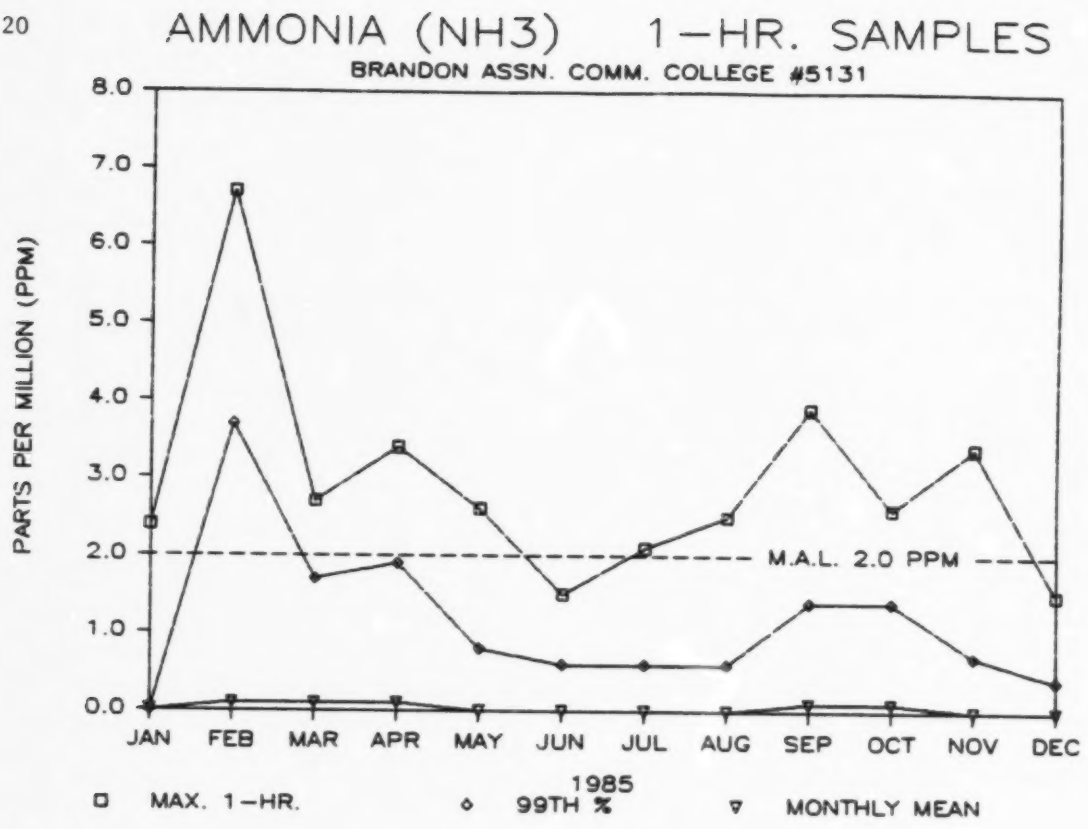

AMMONIA (NH3) 1-HR. SAMPLES
BRANDON ASSN. COMM. COLLEGE #5131
PARTS PER MILLION (PPM)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
M.A.L. 2.0 PPM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985
MAX. 1-HR.
99TH %
MONTHLY MEAN

Fig. 21

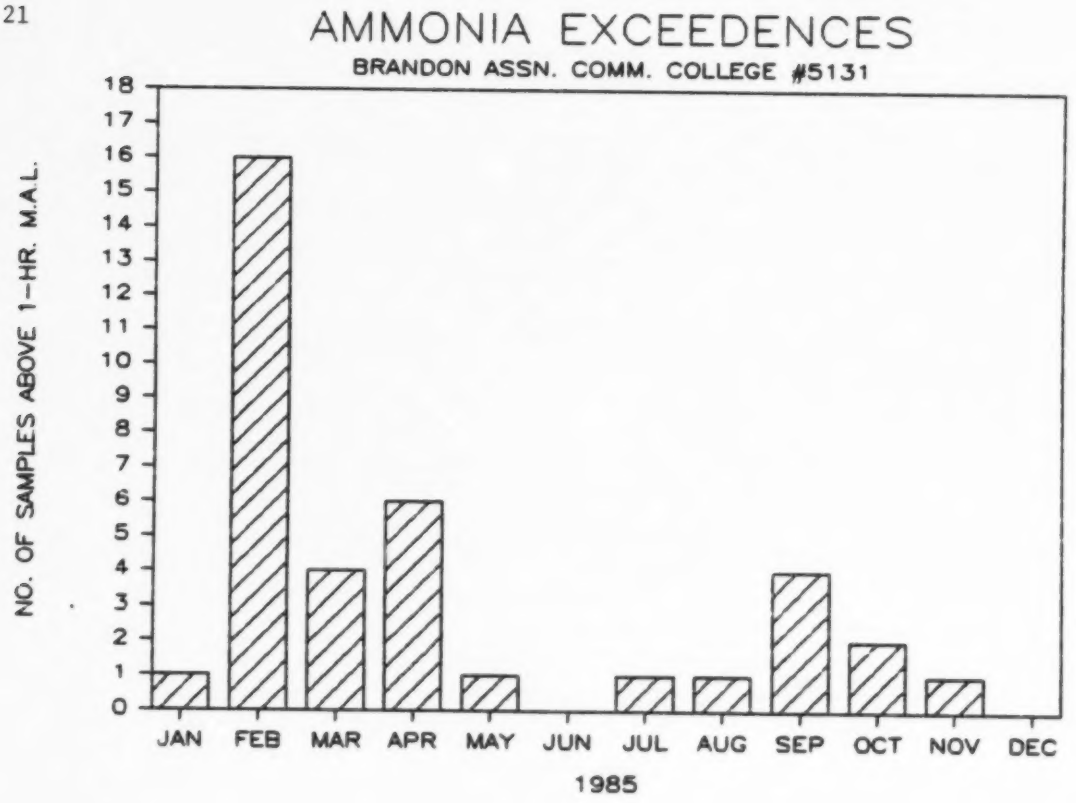

AMMONIA EXCEEDENCES
BRANDON ASSN. COMM. COLLEGE #5131
NO. OF SAMPLES ABOVE 1-HR. M.A.L.
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 22 HYDROGEN SULPHIDE (H2S) 1-HR.SAMPLES

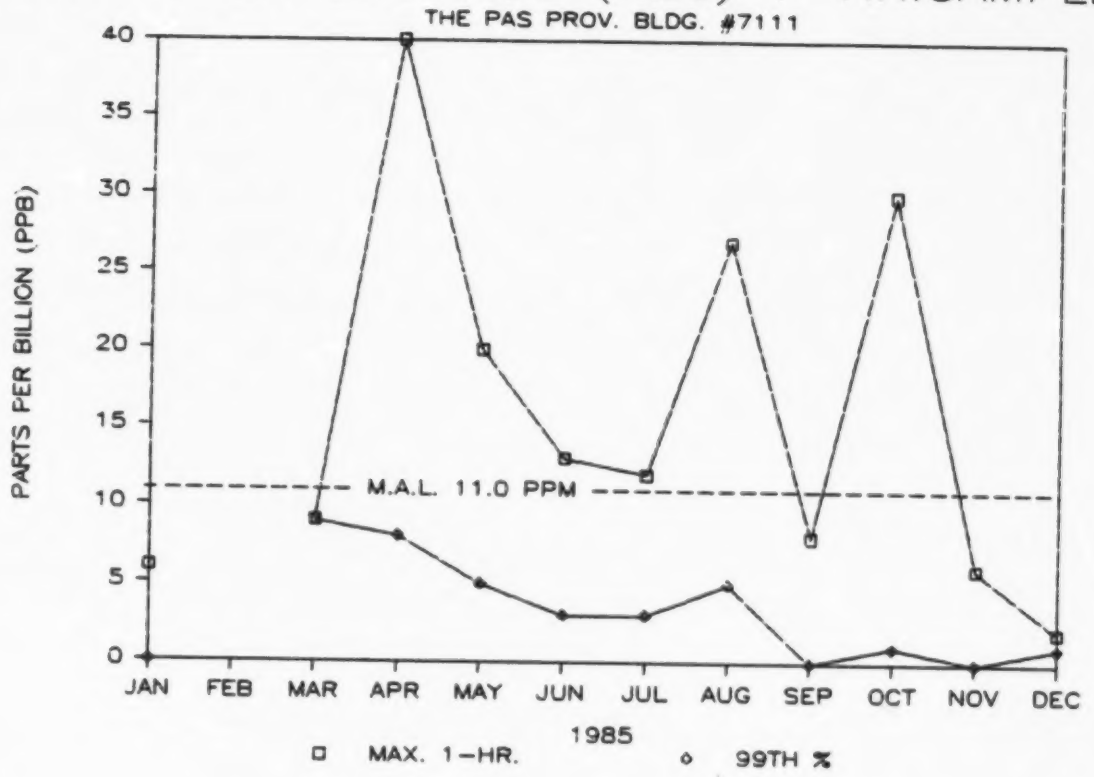


Fig. 23 SULPHUR DIOXIDE (SO2) 1–HR. SAMPLES

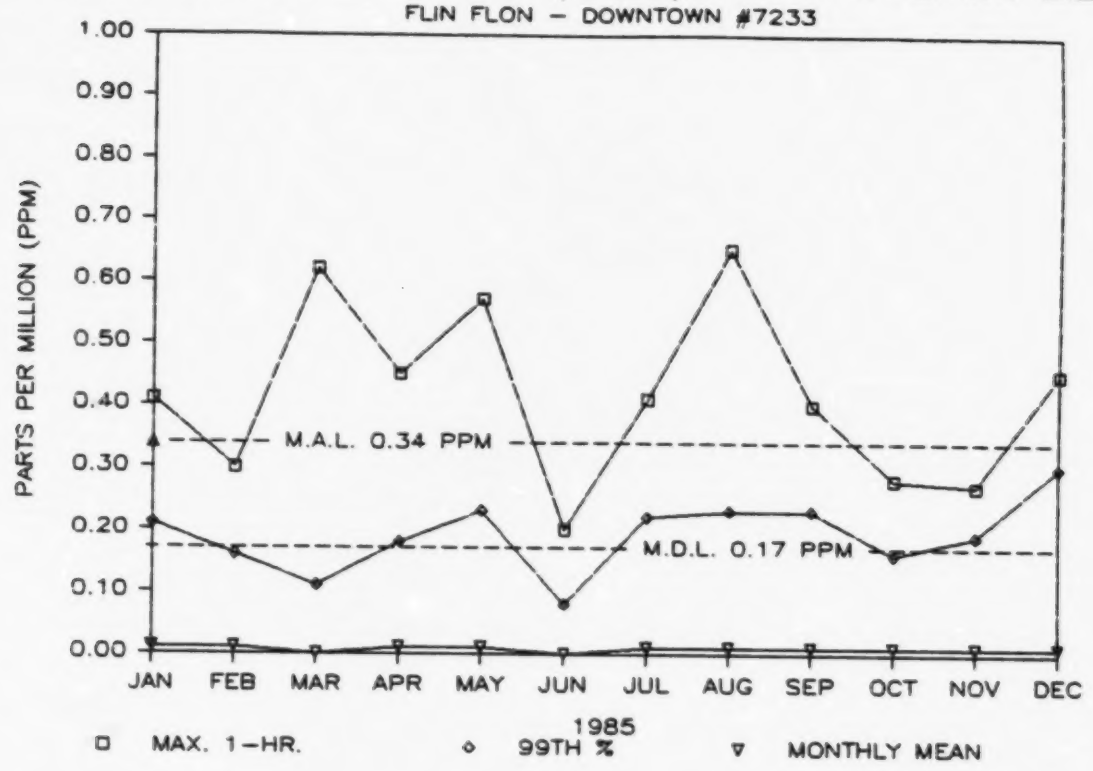


Fig. 24 SULPHUR DIOXIDE (SO2) 1–HR. SAMPLES

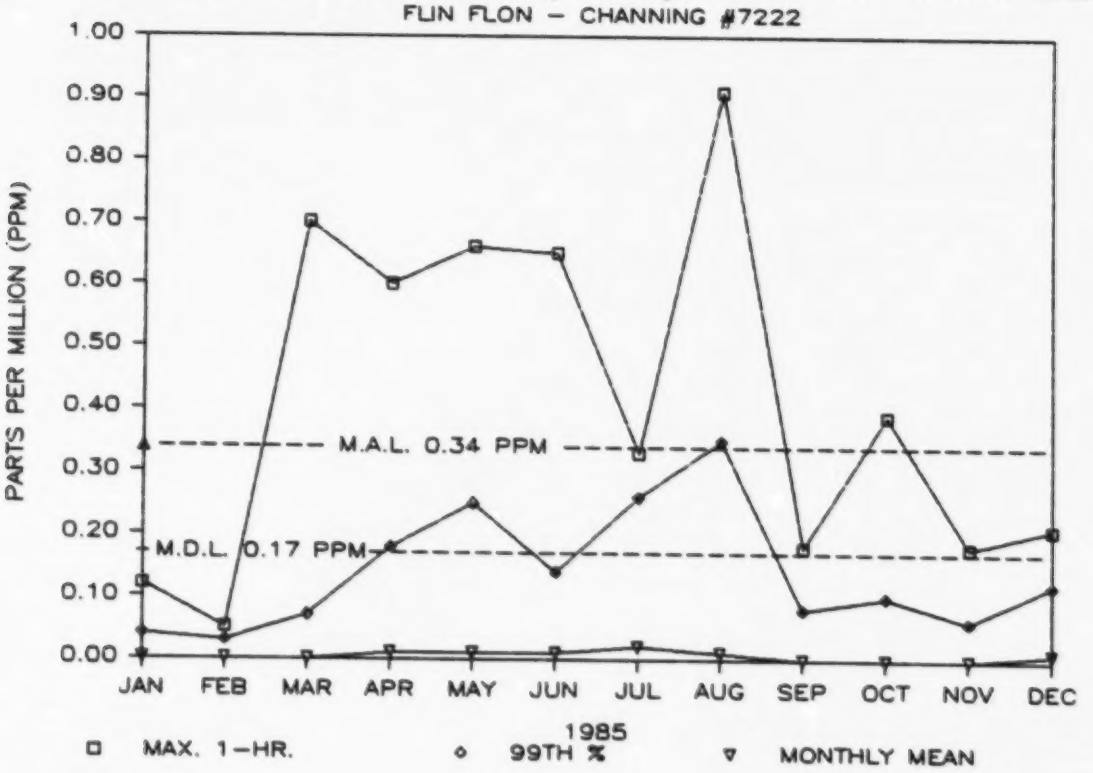


Fig. 25 SULPHUR DIOXIDE (SO2) 1-HR. SAMPLES

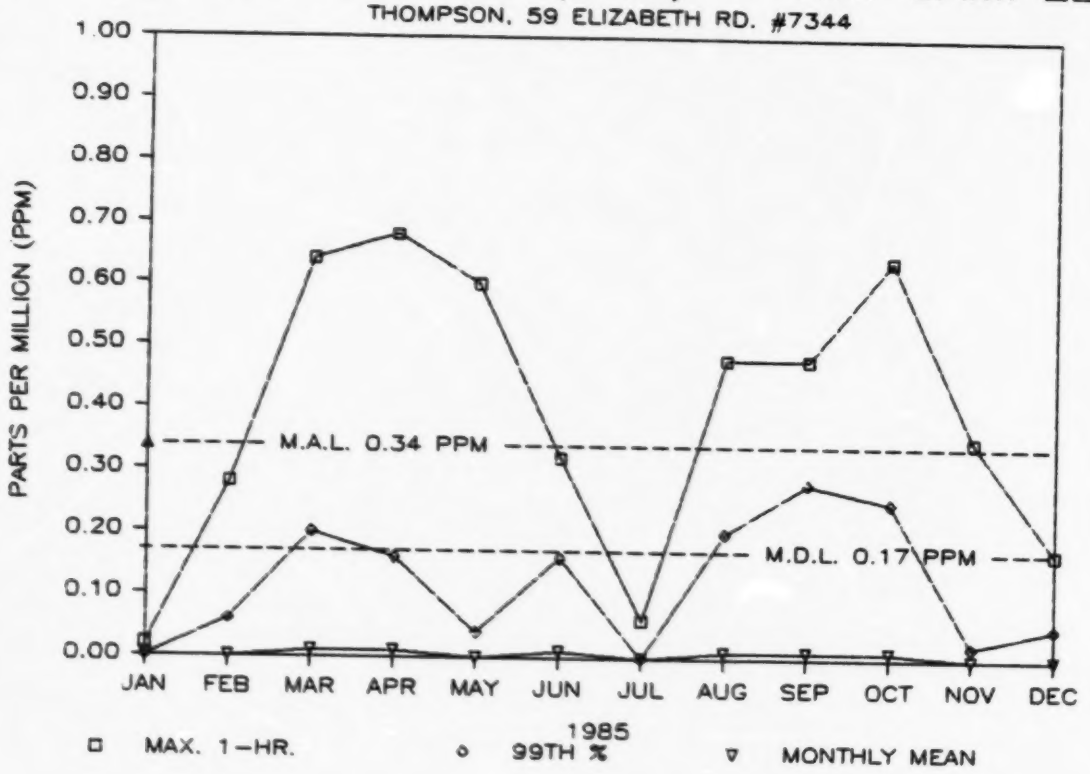


Fig. 26

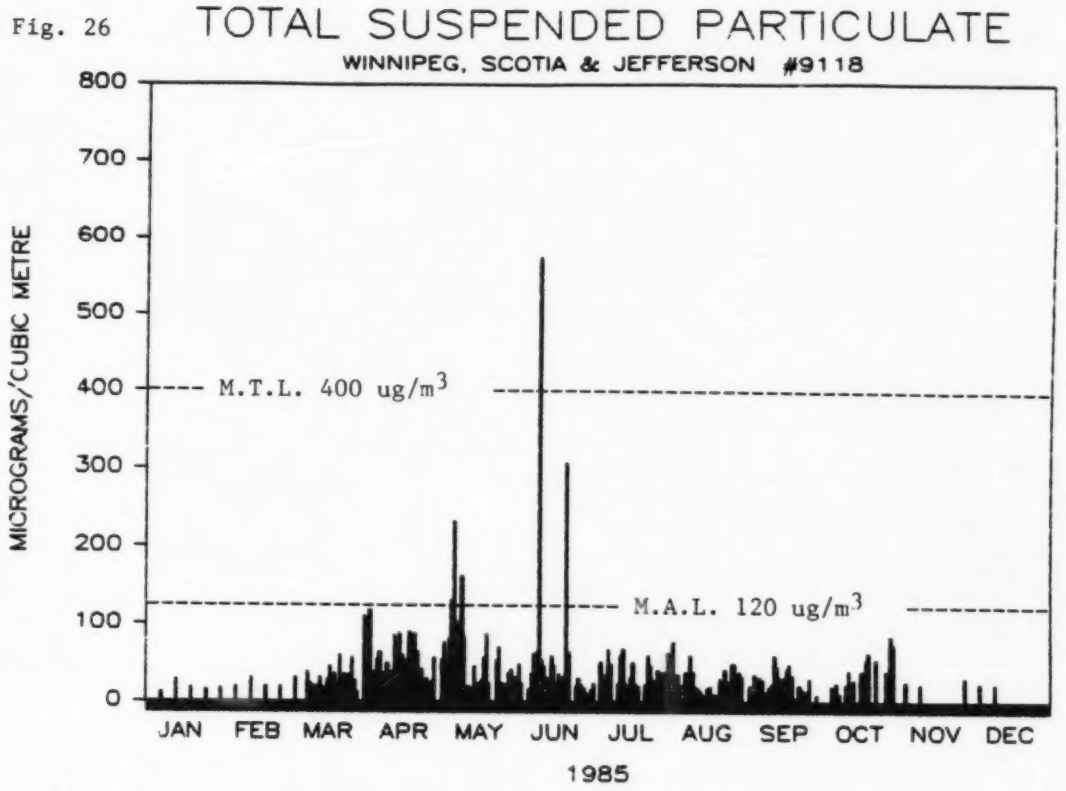

TOTAL SUSPENDED PARTICULATE
WINNIPEG, SCOTIA & JEFFERSON #9118
MICROGRAMS/CUBIC METRE
800
700
600
500
400
300
200
100
0
M.T.L. 400 ug/m3
M.A.L. 120 ug/m3
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 27

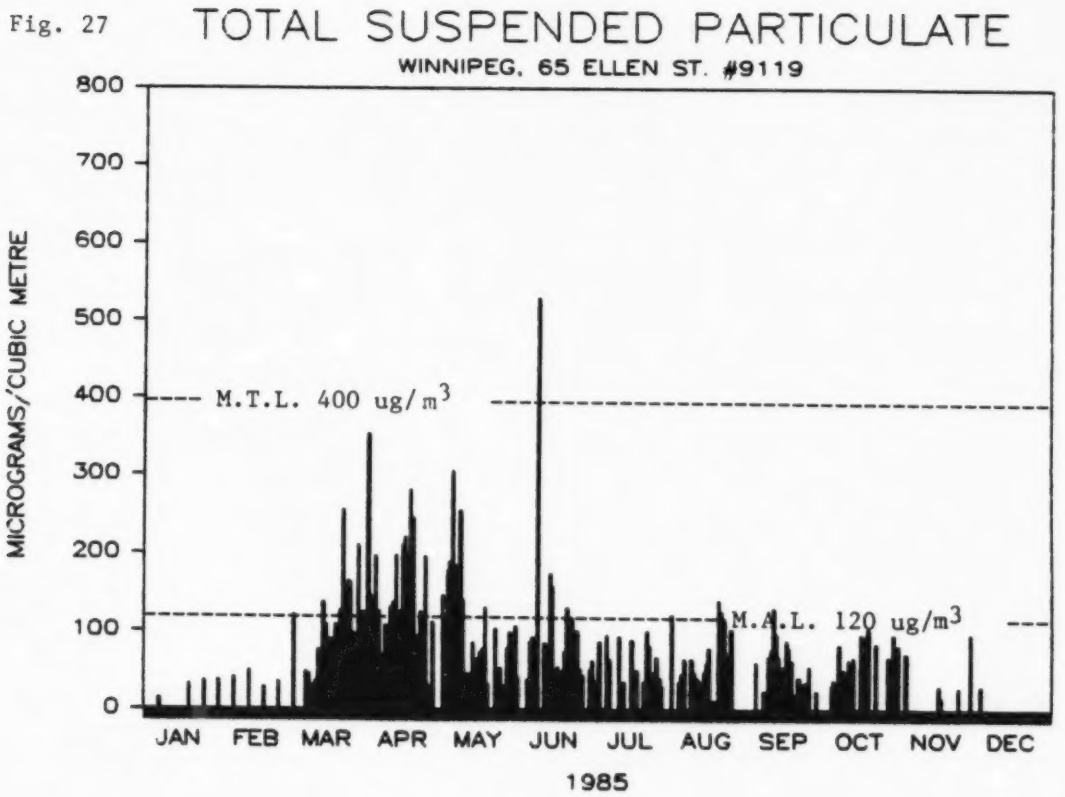

TOTAL SUSPENDED PARTICULATE
WINNIPEG, 65 ELLEN ST. #9119
MICROGRAMS/CUBIC METRE
800
700
600
500
400
300
200
100
0
M.T.L. 400 ug/m3
M.A.L. 120 ug/m3
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 28

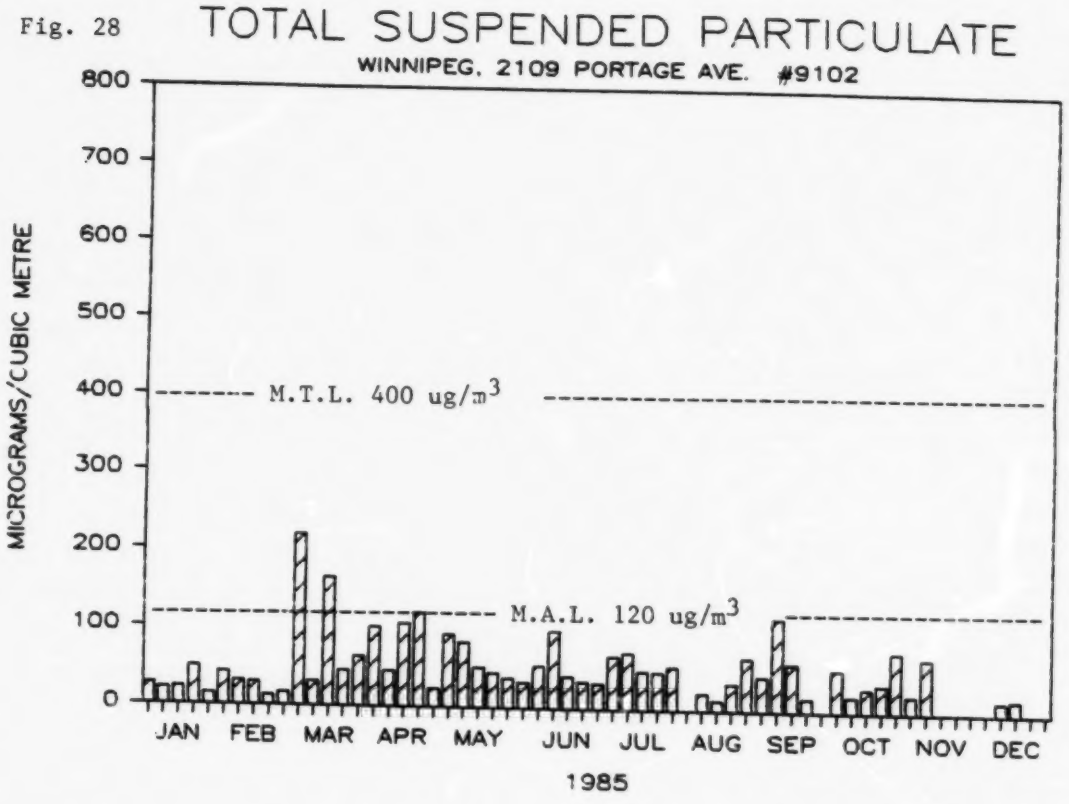

TOTAL SUSPENDED PARTICULATE
WINNIPEG, 2109 PORTAGE AVE. #9102
MICROGRAMS/CUBIC METRE
800
700
600
500
400
300
200
100
0
M.T.L. 400 ug/m3
M.A.L. 120 ug/m3
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 29

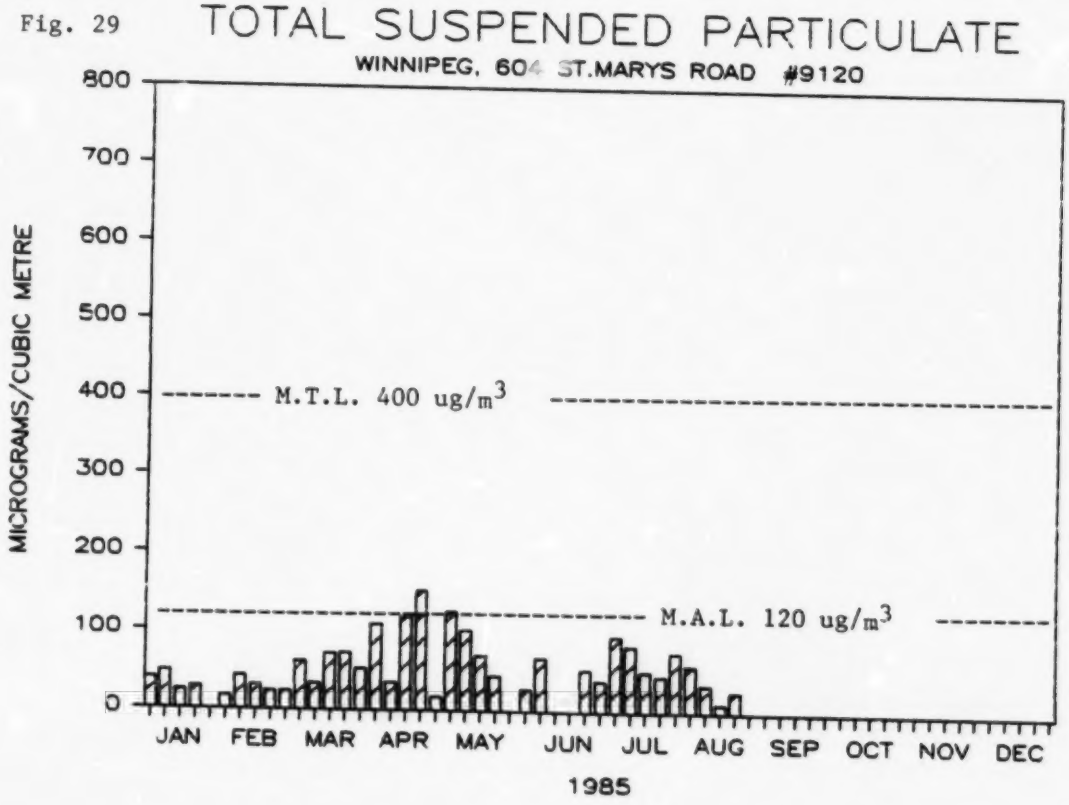

TOTAL SUSPENDED PARTICULATE
WINNIPEG, 604 ST.MARYS ROAD #9120
MICROGRAMS/CUBIC METRE
800
700
600
500
400
300
200
100
0
M.T.L. 400 ug/m3
M.A.L. 120 ug/m3
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 30

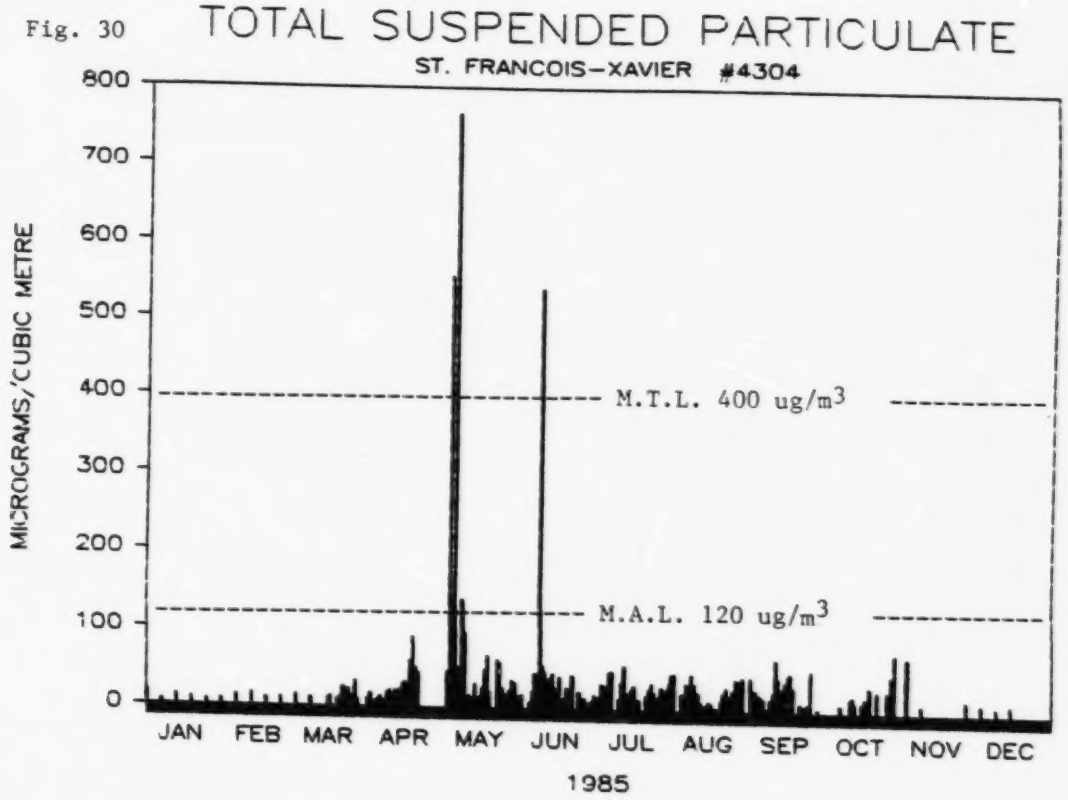

TOTAL SUSPENDED PARTICULATE
ST. FRANCOIS-XAVIER #4304
MICROGRAMS/CUBIC METRE
800
700
600
500
400
300
200
100
0
M.T.L. 400 ug/m3
M.A.L. 120 ug/m3
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 31

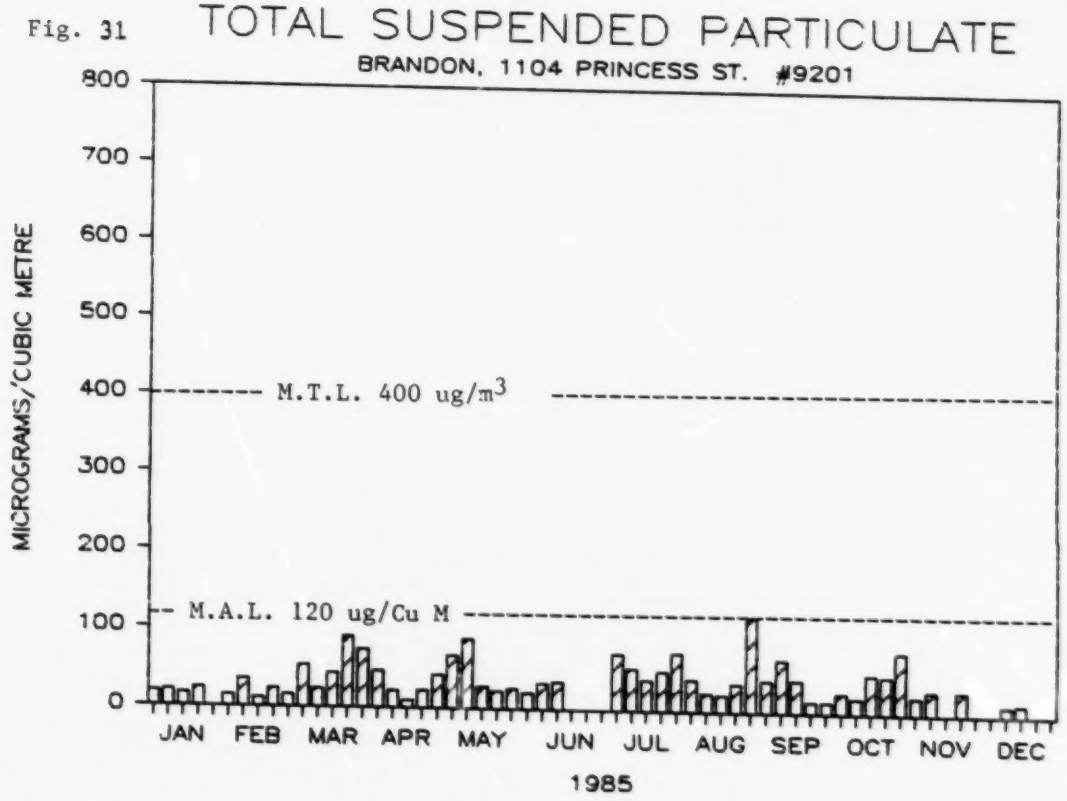

TOTAL SUSPENDED PARTICULATE
BRANDON, 1104 PRINCESS ST. #9201
MICROGRAMS/CUBIC METRE
800
700
600
500
400
300
200
100
0
M.T.L. 400 ug/m3
M.A.L. 120 ug/Cu M
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 32

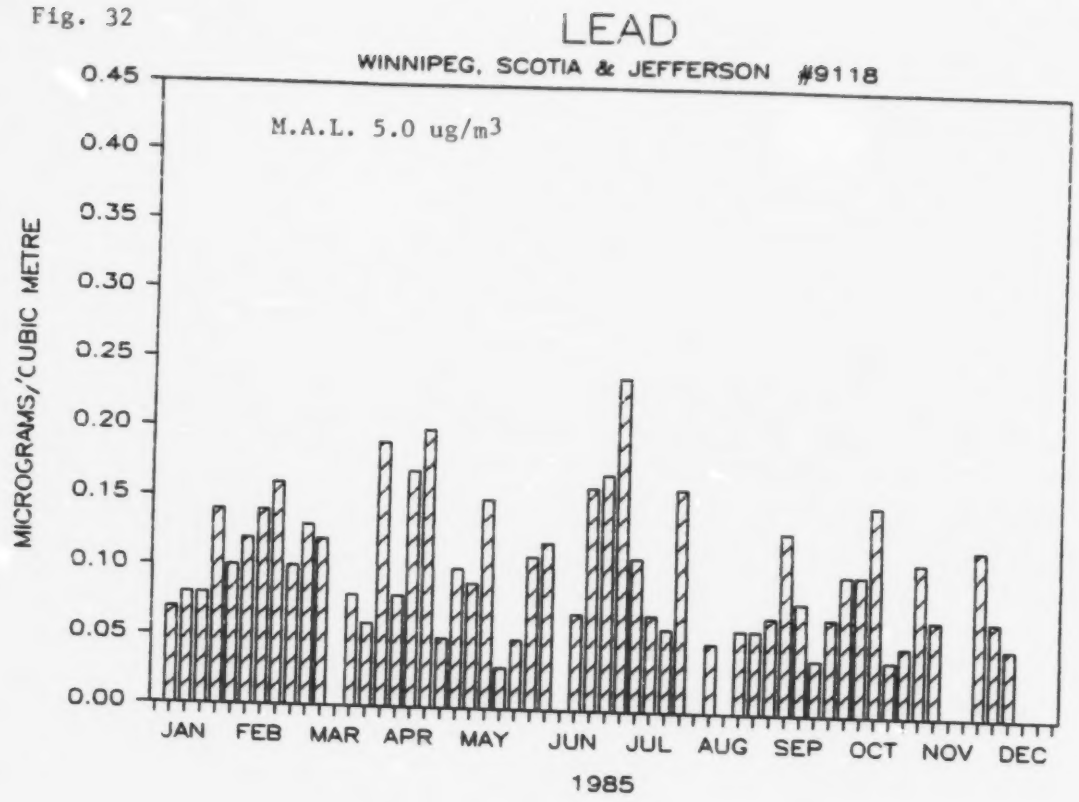

LEAD
WINNIPEG, SCOTIA & JEFFERSON #9118
M.A.L. 5.0 ug/m3
MICROGRAMS/CUBIC METRE
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 33

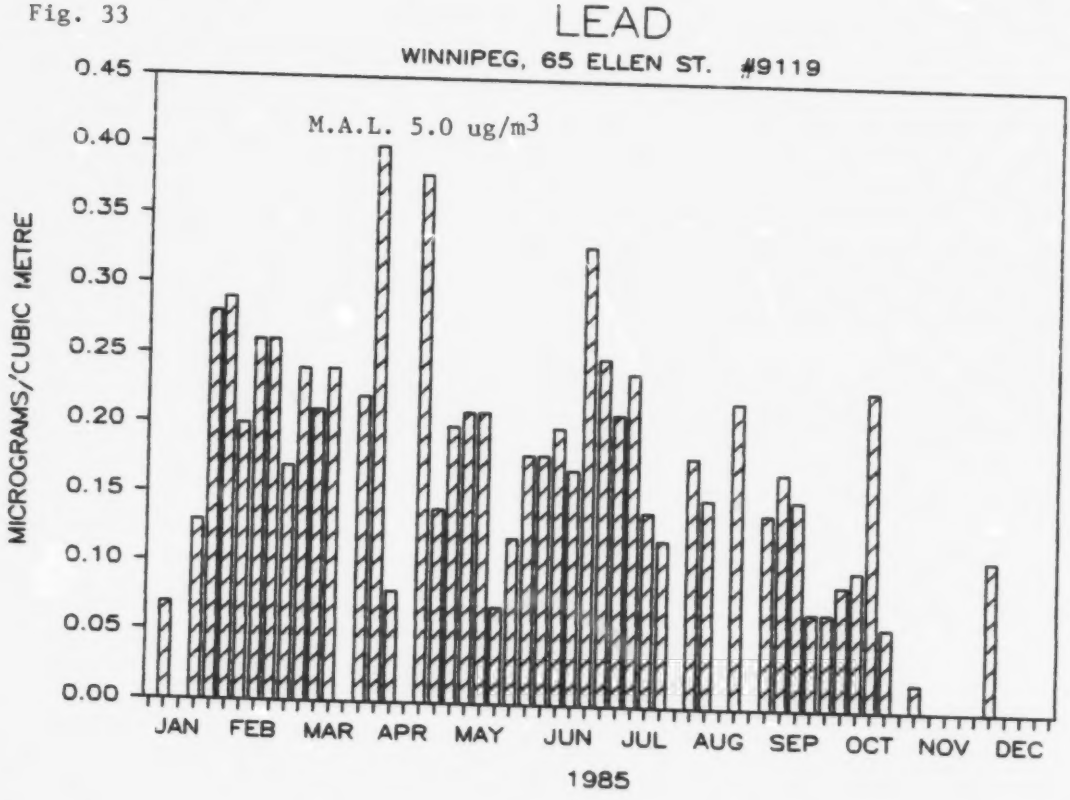

LEAD
WINNIPEG, 65 ELLEN ST. #9119
M.A.L. 5.0 ug/m3
MICROGRAMS/CUBIC METRE
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 34

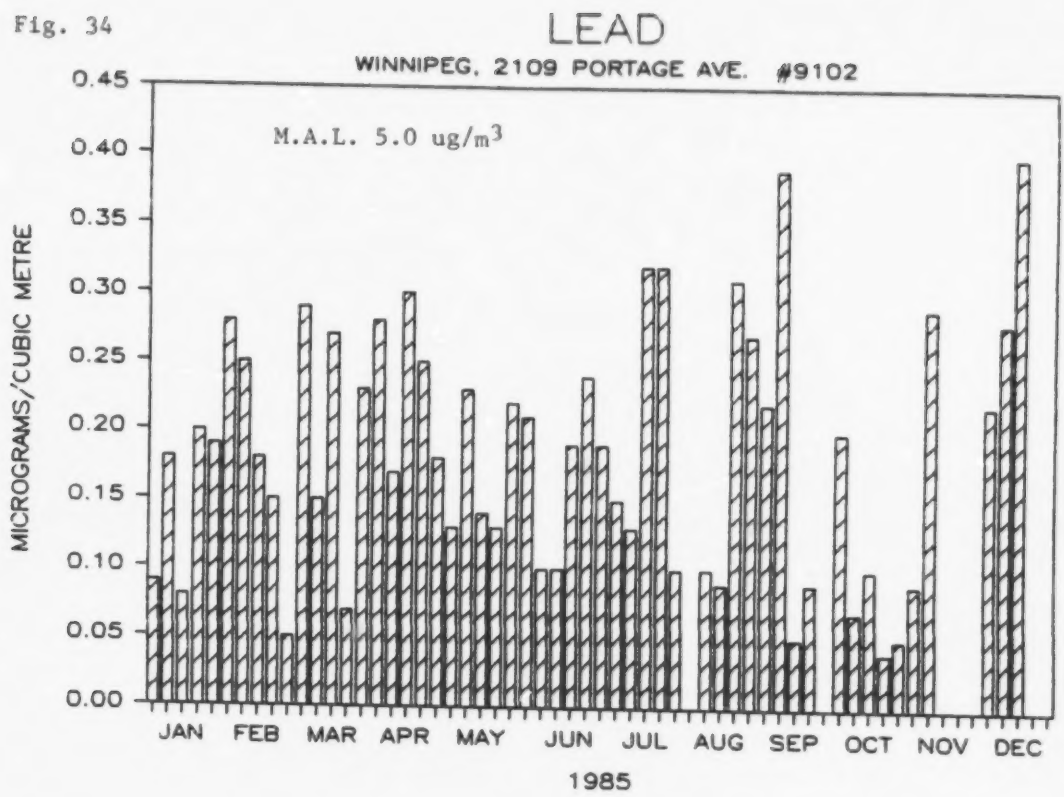

LEAD
WINNIPEG, 2109 PORTAGE AVE. #9102
M.A.L. 5.0 ug/m3
MICROGRAMS/CUBIC METRE
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 35

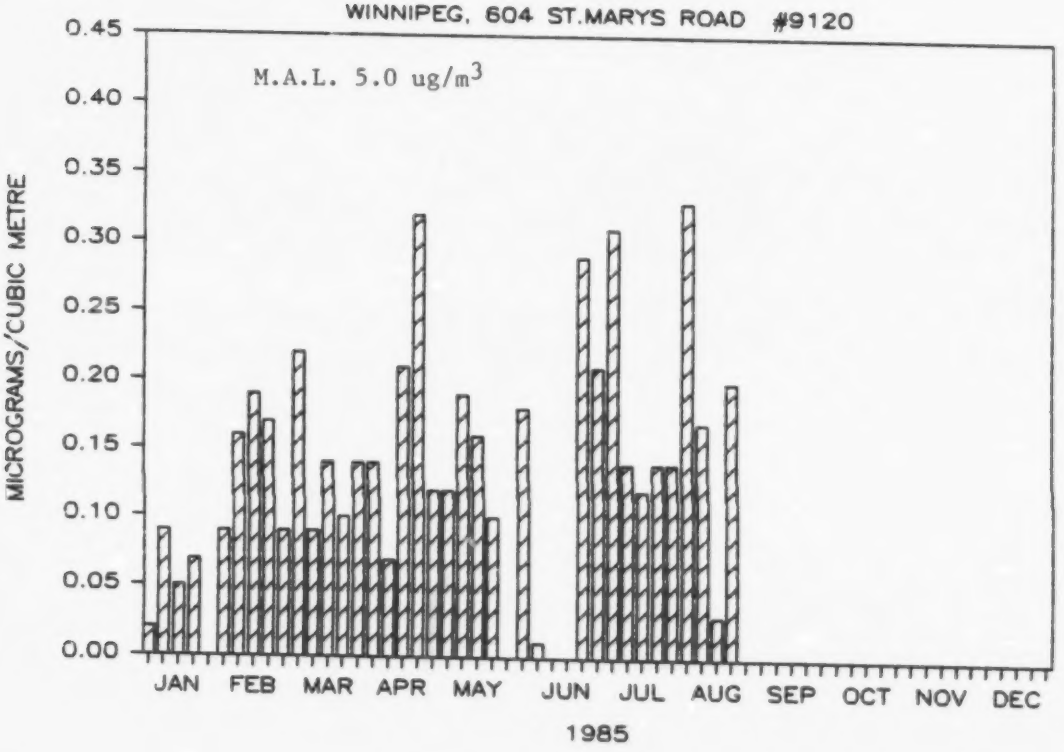

LEAD
WINNIPEG, 604 ST.MARYS ROAD #9120
M.A.L. 5.0 ug/m3
MICROGRAMS/CUBIC METRE
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 36

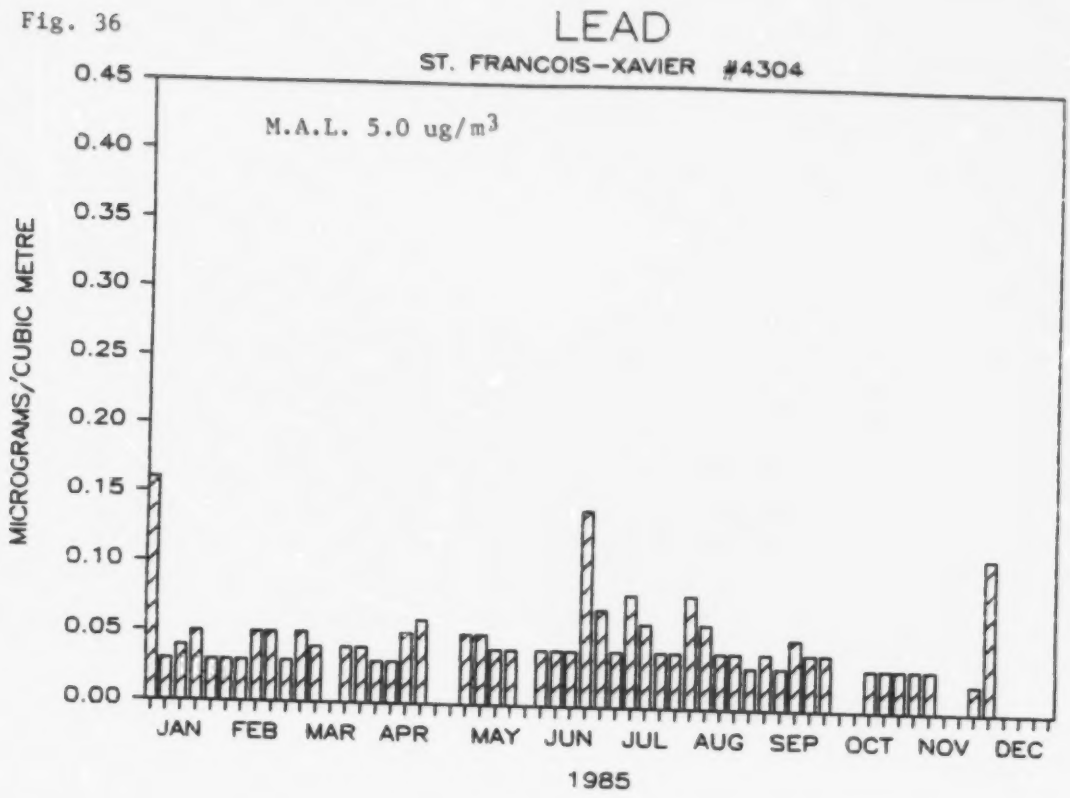

LEAD
ST. FRANCOIS-XAVIER #4304
M.A.L. 5.0 ug/m3
MICROGRAMS/CUBIC METRE
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 37

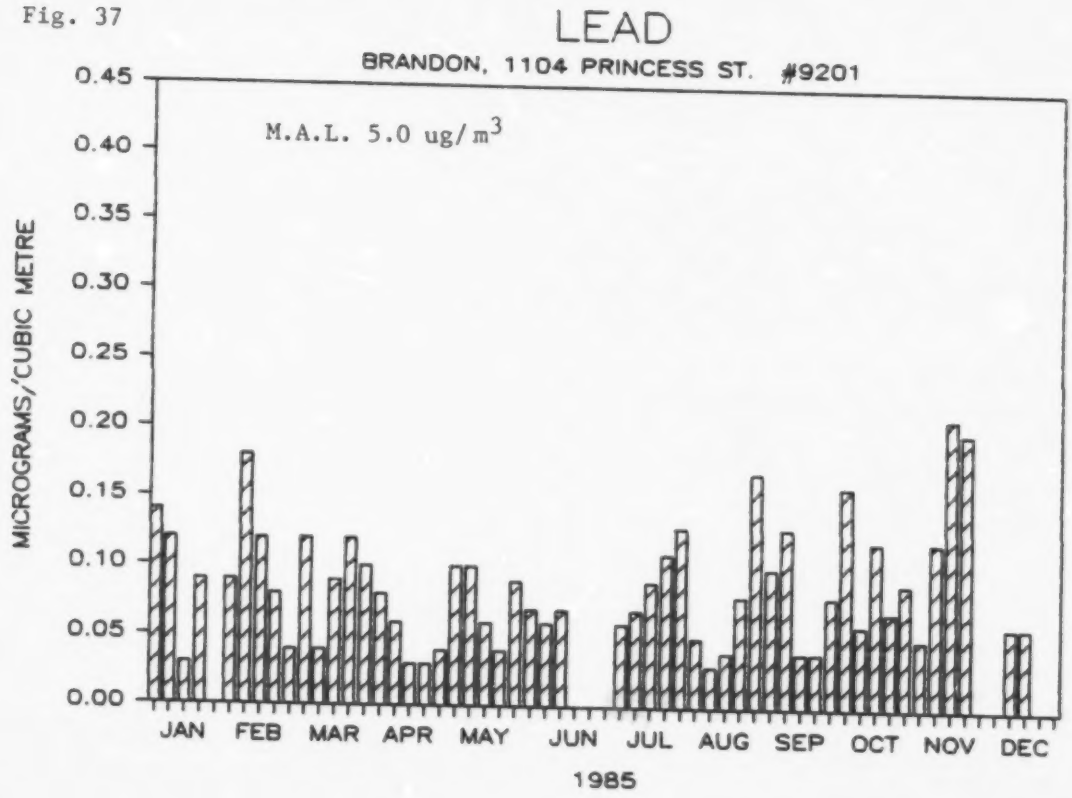

LEAD
BRANDON, 1104 PRINCESS ST. #9201
M.A.L. 5.0 ug/m3
MICROGRAMS/CUBIC METRE
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 38

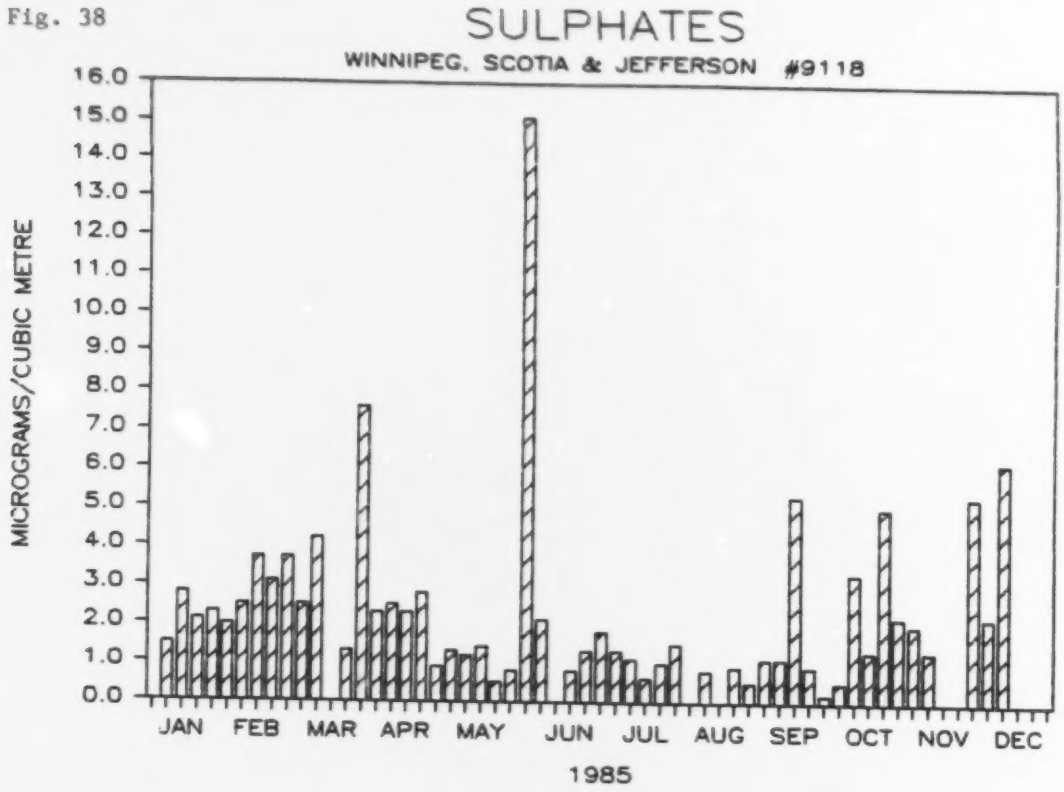

SULPHATES
WINNIPEG, SCOTIA & JEFFERSON #9118
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 39

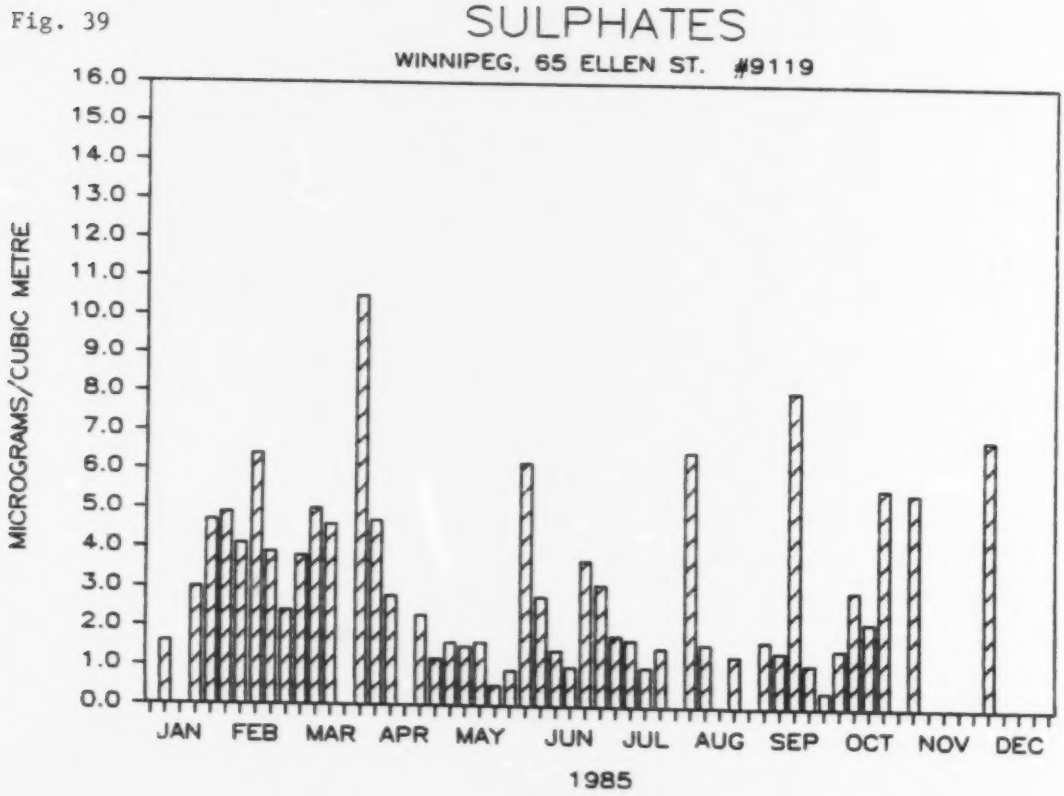

SULPHATES
WINNIPEG, 65 ELLEN ST. #9119
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 40

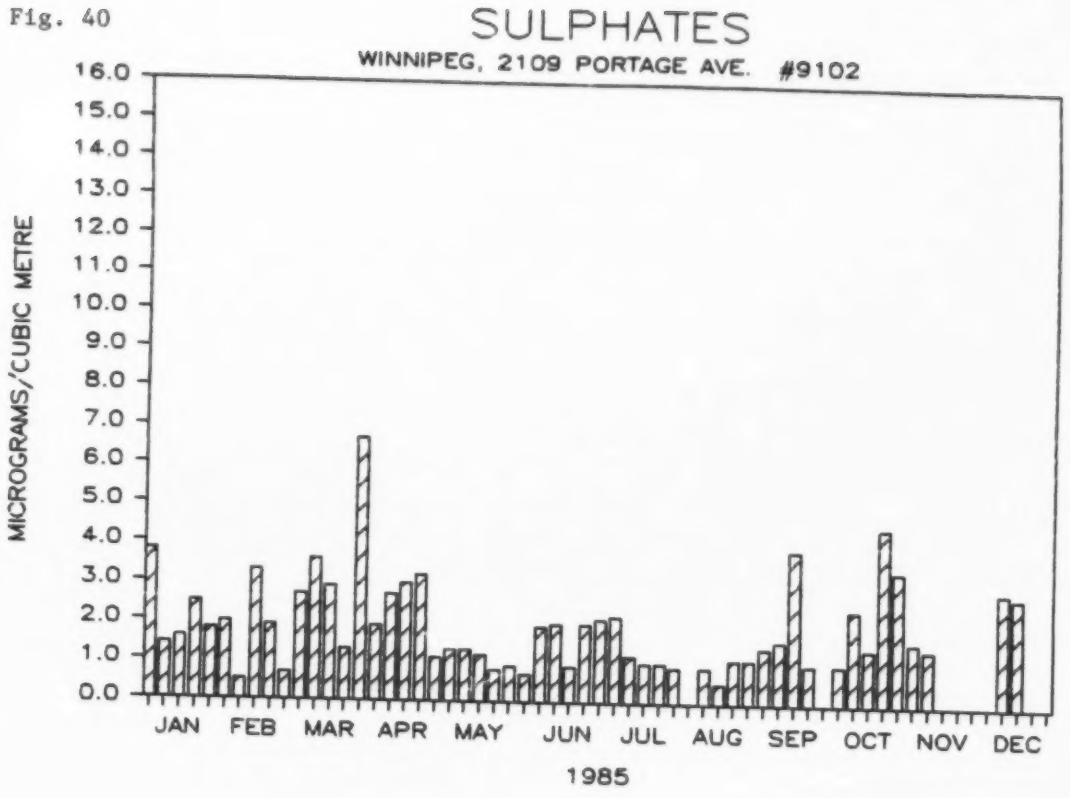

SULPHATES
WINNIPEG, 2109 PORTAGE AVE. #9102
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 41

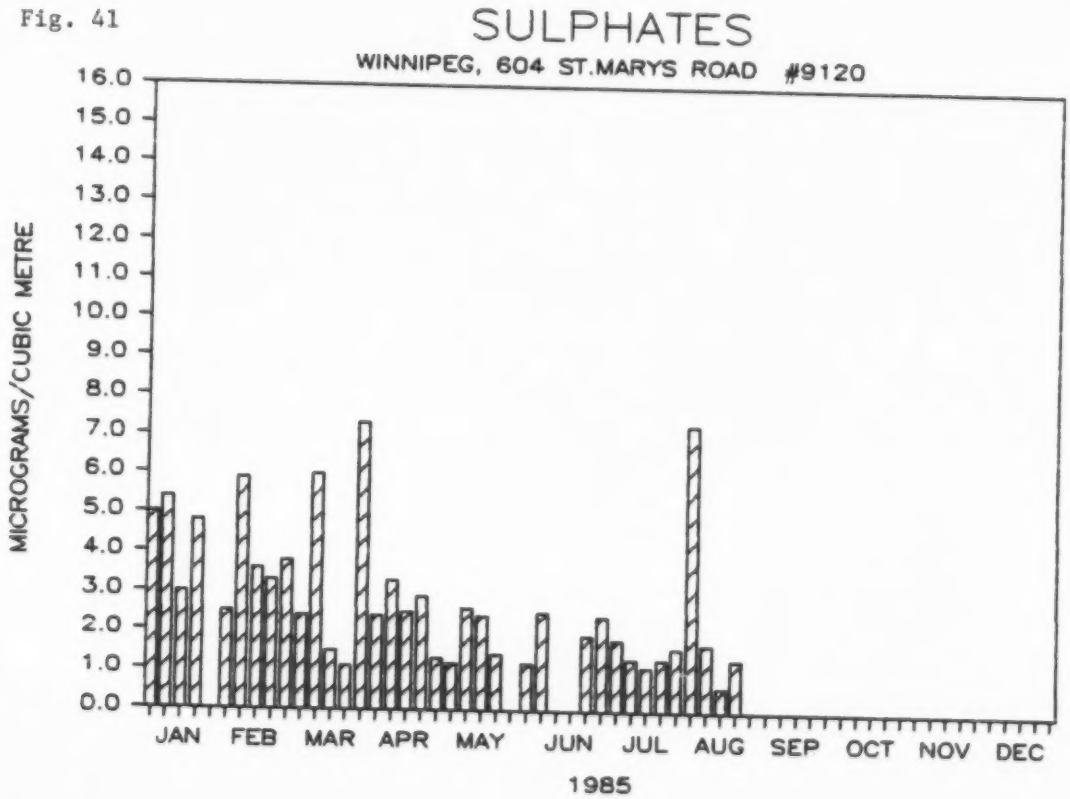

SULPHATES
WINNIPEG, 604 ST.MARYS ROAD #9120
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 42

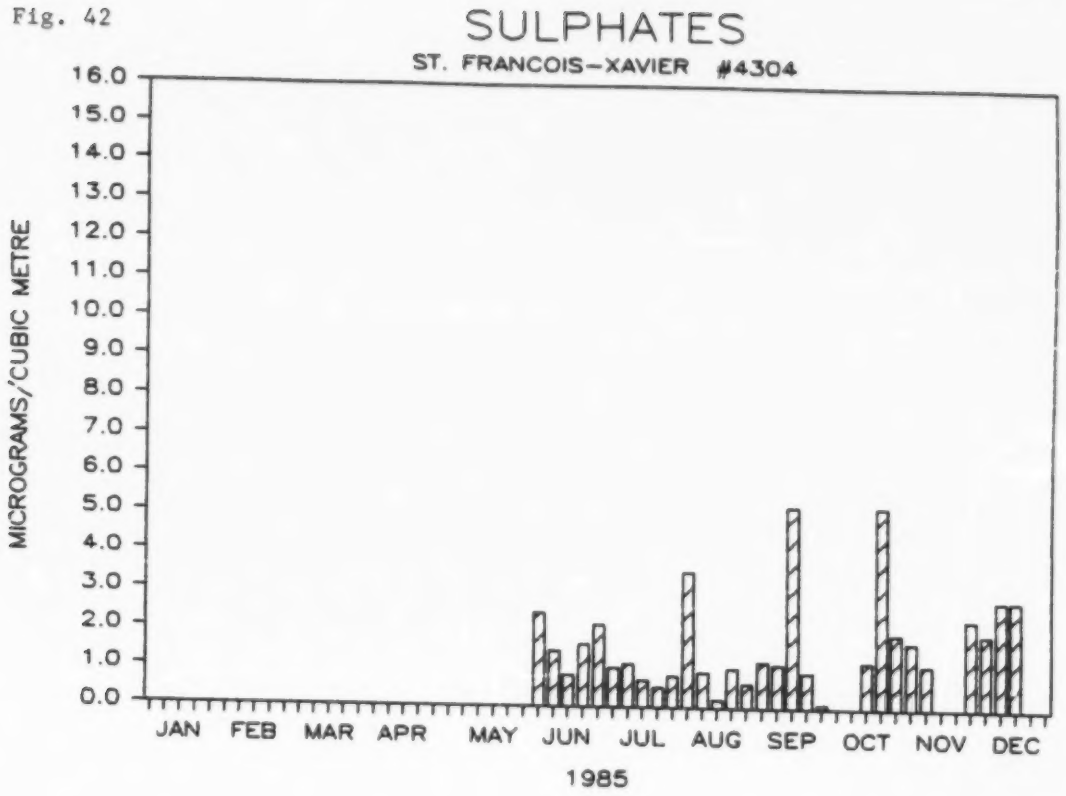

SULPHATES
ST. FRANCOIS-XAVIER #4304
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 43

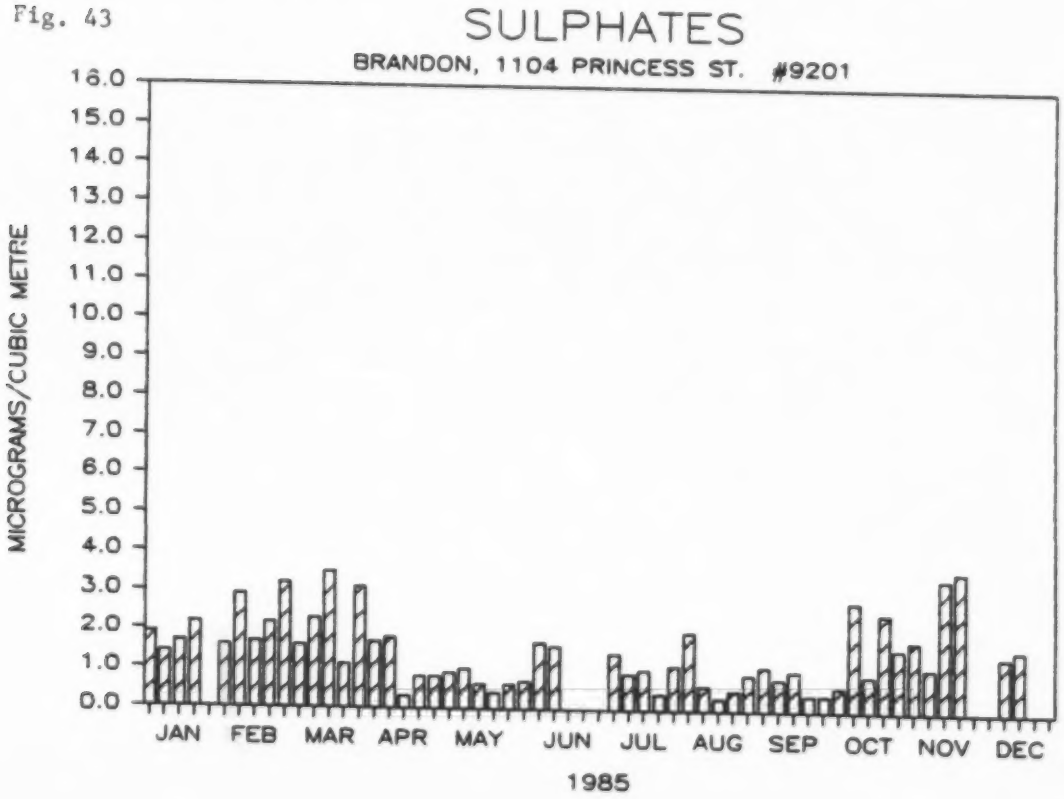

SULPHATES
BRANDON, 1104 PRINCESS ST. #9201
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 44

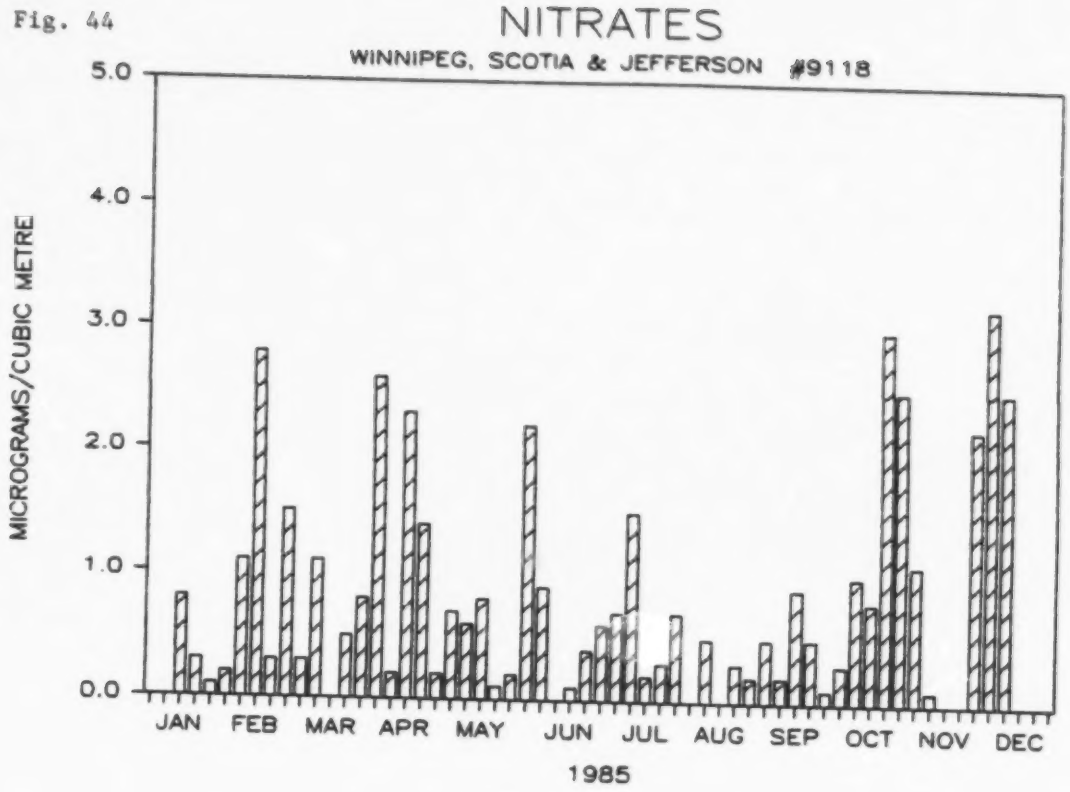

NITRATES
WINNIPEG, SCOTIA & JEFFERSON #9118
MICROGRAMS/CUBIC METRE
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 45

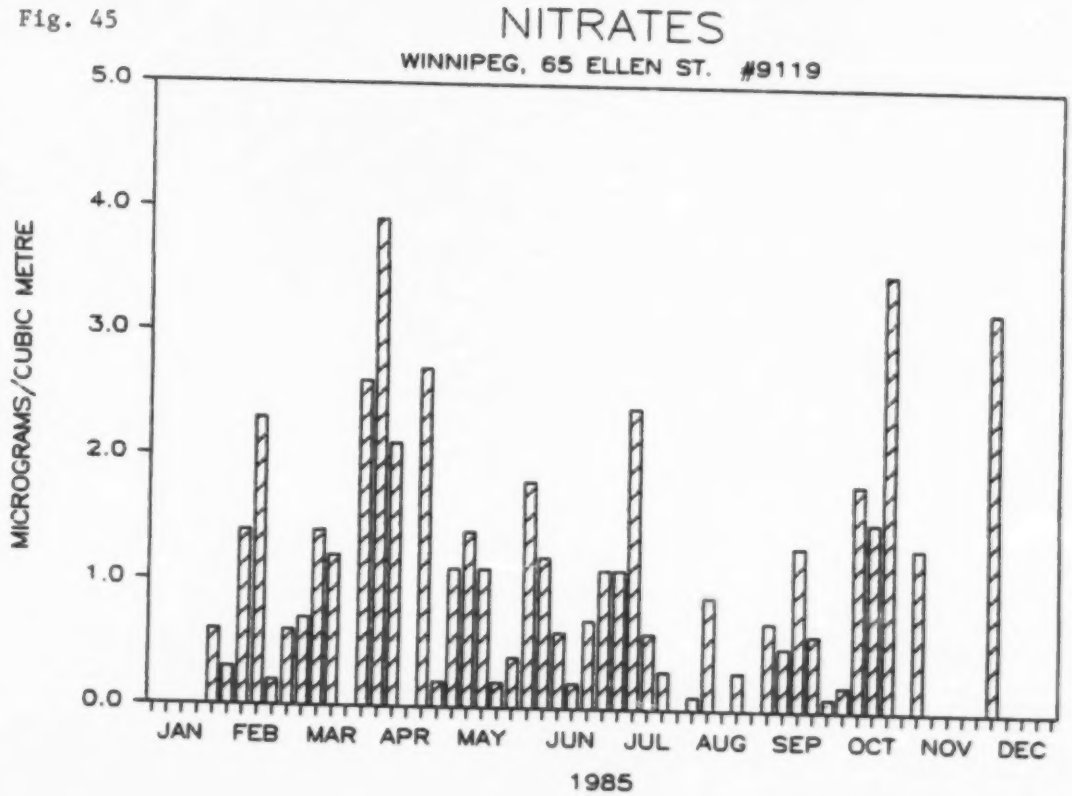

NITRATES
WINNIPEG, 65 ELLEN ST. #9119
MICROGRAMS/CUBIC METRE
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 46

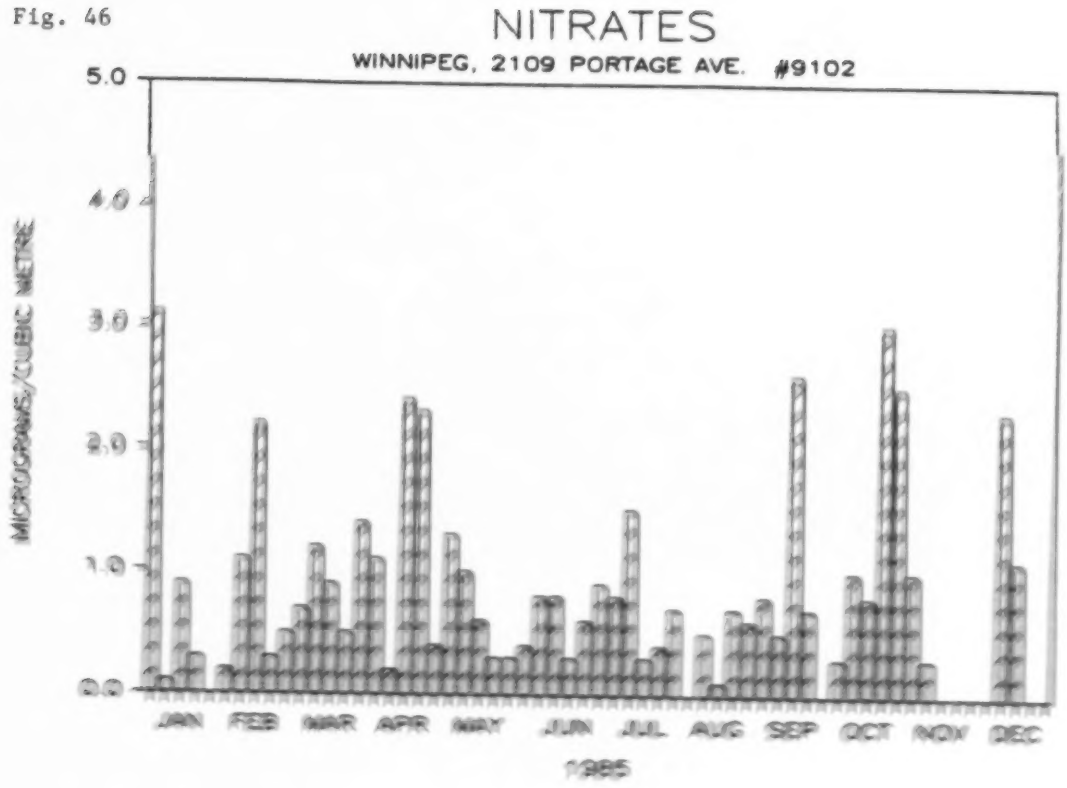

NITRATES
WINNIPEG, 2109 PORTAGE AVE. #9102
MICROGRAMS/CUBIC METRE
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 47

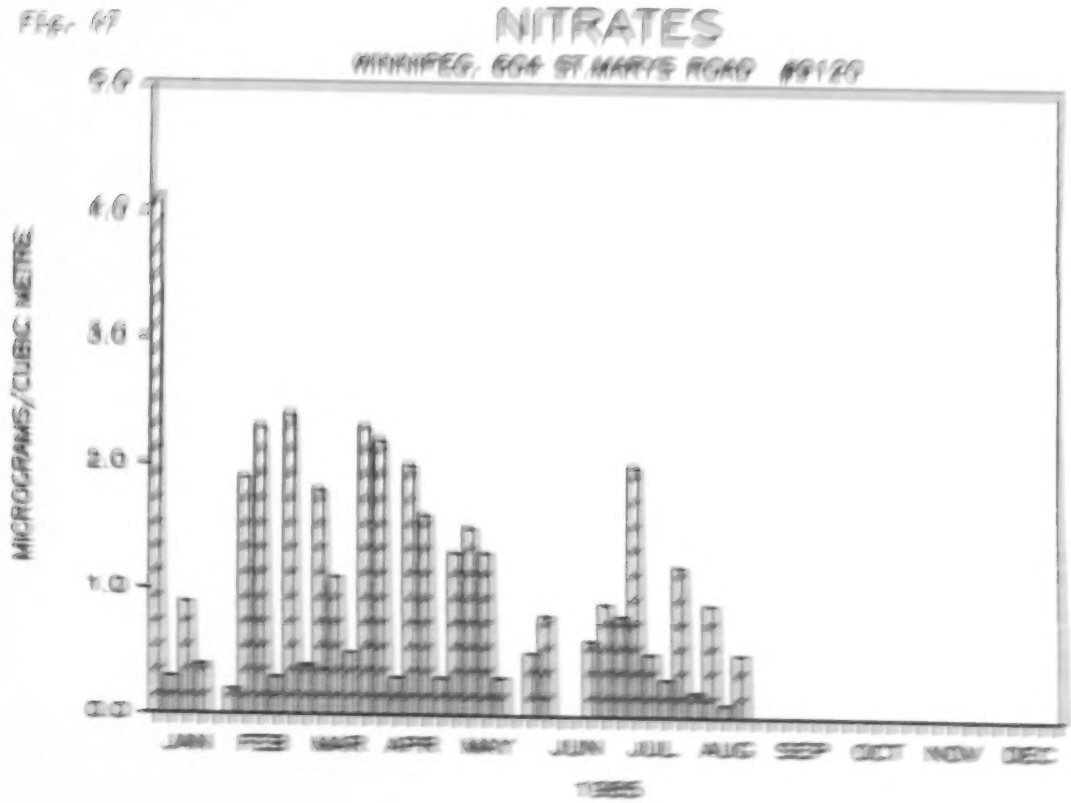

NITRATES
WINNIPEG, 604 ST. MARYS ROAD #9120
MICROGRAMS/CUBIC METRE
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 48

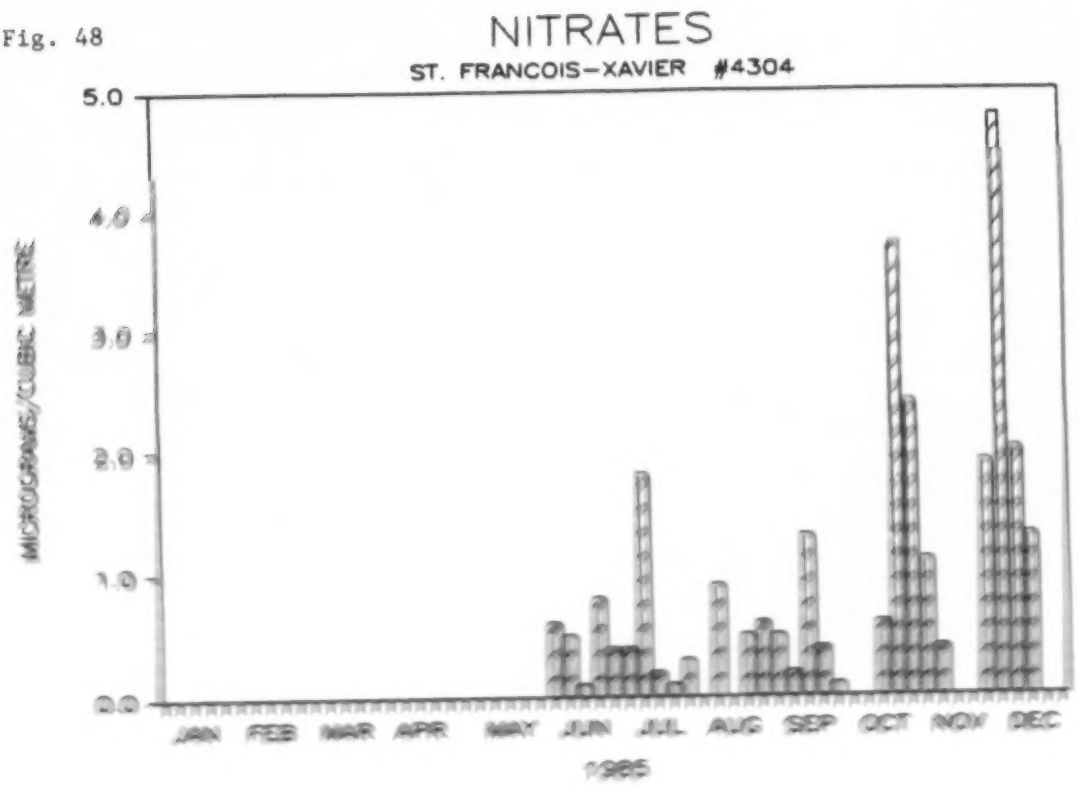
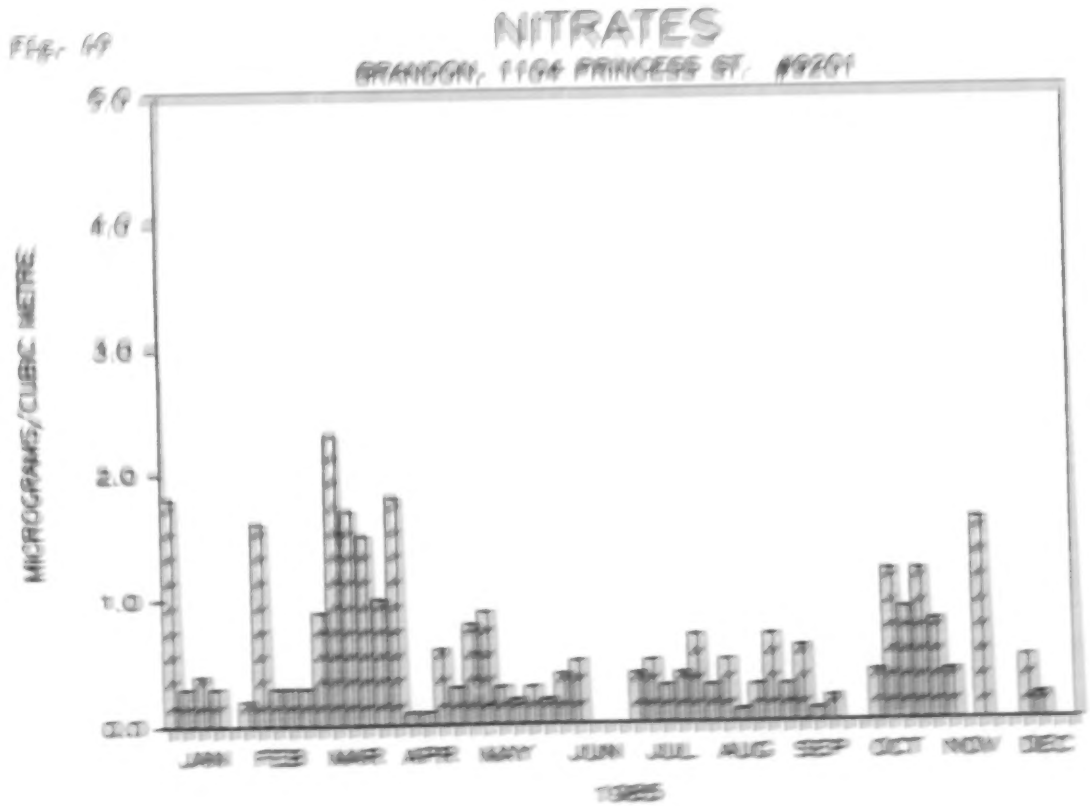

NITRATES
ST. FRANCOIS-XAVIER #4304
MICROGRAMS/CUBIC METRE
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985

Fig. 49


NITRATES
BRANDON, 1104 PRINCESS ST. #9201
MICROGRAMS/CUBIC METRE
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1985